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ABSTRACT

The 2000 WebNet conference addressed research, new developments, and experiences related to the Internet and World Wide Web. The 319 contributions of WebNet 2000 contained in this proceedings comprise the full and short papers accepted for presentation at the conference, as well as poster/demonstration abstracts. Major topics covered include: commercial, business, professional, and community applications; education applications; electronic publishing and digital libraries; ergonomic, interface, and cognitive issues; general Web tools and facilities; medical applications of the Web; personal applications and environments; societal issues, including legal, standards, and international issues; and Web technical facilities. (MES)

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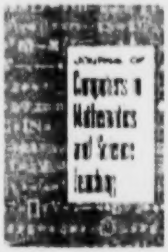

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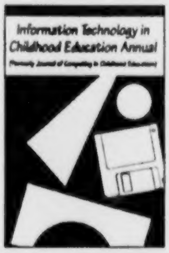

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CORPORATE DEMONSTRATION

The Business of eLearing: Creating a Revenue Channel

Thomas B. Christel, Vice President, Viviance new education (tchristel@viviance.com)

Online education and eLearning is the new paradigm shaping the web. In the mid-eighties, brochureware hit the web, closely followed by customer support. The next step was eCommerce for commodity goods, until recently being introduced to eCommerce for education and services.

Like your basic utilities of electricity, water and Internet access, education is a basic need and requirement of our industrialized society. The web has opened the door to bring education to you, your employees, partners and customers, 24 hours a day, 7 days a week, 52 weeks a year for the rest of your life at home, work or play. It has become Education on tap!

So you ask yourself, how do I tap this business opportunity? We will discuss a formula, process and a number of helpful steps to get started in building a profitable online education revenue channel. Included will be case study examples.

About the Presenter: Thomas B. Christel, has over 18 years experience in the high tech industry, with such companies as IBM, Andersen Consulting and Ameritech and now serves as Vice President, Worldwide Marketing for Viviance new education. (www.viviance.com) or 1-877-4-NEW-EDU (639-338).

Centre for Nursing and Health Studies an Online Perspective

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Abstract: Athabasca University is one of the worlds leading open universities specializing in distance education. The Centre for Nursing and Health Studies at Athabasca University currently offers both Undergraduate and Graduate courses online via the Internet. We have created a highly interactive learning environment for health professionals by integrating a central website with student and instructor course tools. Students and Faculty have the opportunity to collaborate using an Online Study Guide, Email, Chat, and Grading Tools. We have strived to ensure that learning tools incorporated during the design and development process are both pedagogically sound and user friendly. The benefits and drawbacks of offering a fully integrated online health studies program will be explored and explained.

A definitive Online Distance Learning Model (ODL) for a Telecommunication Company: a Corporate Showcase

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The CRT Online Distance Learning System is a multiplataform service structure created to support a new corporate media of education based on Intranet and aimed to a telecommunication company employees. This system proposes a low cost and very easy access educational system.

With a combination of distributed systems like a Corporate Television and all the benefits of Intranet, CRT ODL is now covering all areas of a telecommunication training.

As results, Company saved about 80 % on costs for this same type of training as if it were performed on a traditional basis. People enjoyed this new kind of training since they could take at their most convenient time.

Media Analysis Tools Workshop

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Abstract: How are delivery media selected in your organization? "Flavor of the month?" "What has always been done before?" "What management or the customer dictates?" Is there a certain sequence of events that lead to the selection of the most appropriate delivery media for a particular business issue? If you answer "Yes" to any of the choices of how media are selected and are uncertain about the sequence of events, read on! There is a systematic process for media selection that begins with an organizational assessment, resulting in objectives for the solution, leading to the selection of the most appropriate media. There are also tools associated with each of the parts of this system; a system considered by many to be the most complete media analysis and selection model in existence today. **All session participants will receive a complete set of the media analysis tools.**

SYSTEMATIC MODEL DEFINED

A systemic approach to media selection involves more than looking at the training aspects of a business issue or problem. It involves four components that, together, form a Media Analysis Model with accompanying tools to activate the system. The components are:

1. Organizational Assessment
2. Information Structure and Objectives
3. Media Selection
4. Cost Analysis

An organizational assessment requires looking at the performance and systemic issues involved in any business issue over and above (and before) considering any training that might be required.

Information structure is the type of content within the issue. The structure of the information determines the objectives for the desired outcome. Objectives based on the structure of the information then determine the media that will be required to address the issue.

Media analysis involves considering instructional, student and cost aspects of the issue. Many questions must be answered about the end-users as well as considerations around the cost-benefit of the solution.

Cost analysis involves determining if the eventual Return On Investment (ROI) justifies the cost of designing, developing, and implementing the solution.

The complete Media Analysis Model is outlined in Figure 1.

Media Analysis Model			
Organizational Assessment	Information Structure Objectives	Delivery Media	Cost

BEST COPY AVAILABLE

Systemic • Retention • Incentives • Corporate Culture • Decision Making • Approval levels • Communication	Principles Concepts Processes Procedures Facts	Classroom Computer Based Web Based Satellite Broadcast Performance Support	Cost Benefit Analysis Internal Rate of Return Return on Investment
Performance • Work environment • Tools • Processes/ procedures • Expectations • Emphasis	Principles Concepts Processes Procedures Facts	Classroom Computer Based Web Based Satellite Broadcast Performance Support	Cost Benefit Analysis Internal Rate of Return Return on Investment
Training • Knowledge • Skills • Attitudes	Principles Concepts Processes Procedures Facts	Classroom Computer Based Web Based Satellite Broadcast Performance Support	Cost Benefit Analysis Internal Rate of Return Return on Investment

Figure 1 Media Analysis Model

ORIGINS OF THE MODEL

The model is patterned after principles of human performance theory. It is a synthesis of work from the cognitive sciences including the cognitive mapping work of M. David Merrill (1992), learned capabilities of Robert Gagné (1985); work from process engineering of Hammer and Champy (1994); and human performance principles of Thomas Gilbert (1996).

COMPONENTS OF THE MODEL

Organizational Assessment

There are multiple factors within an organization that will impact the success of an intervention designed as a solution to a business issue. An organizational assessment includes examining the three aspects of any issue listed in Figure 1. At the systemic level, the model requires considering elements such as:

1. Retention – personnel turn-over in an organization
2. Incentives – the reward system of a company
3. Corporate culture – the value an organization places on its people, partners, and customers
4. Decision-making levels – is the organization flat or hierarchical; how many levels of management are there
5. Approval levels – the level of authority at which decisions can be made
6. Communication – the way that information flows up and down in the organization; how and how much information is shared

Examining Performance issues requires discovering elements of:

1. Work environment – the physical conditions under which people do their work
2. Tools – the equipment available to accomplish work
3. Processes and procedures – the systematic methodologies in place that inform people how to accomplish their work
4. Expectations – criteria constituting a job well-done
5. Emphasis – the quality standards (is there are zero defect model or is the objective just to get it out the door)

Training is the transfer of:

1. Knowledge – the information inherent in the issue
2. Skills – the physical and psychomotor capabilities required to complete a job
3. Attitudes – those affective elements that provide the motivation or desire to do a job

Addressing each element discovered during the organizational assessment requires beginning at the highest level – systemic – and working downward to any training issues that might be required for the issue OR by addressing common elements at each level. An example of addressing elements at each level might be:

> Company X needs to get products to market much more quickly to retain its market share. Speed to market for its closest competitor is six months faster than Company X. Among other issues, Company X has identified that the number of approvals required before any purchase of equipment can be made takes four months. This delay makes it impossible for the company to leverage any purchasing power, as bids from vendors are good for only three months. By the time all the required signatures are obtained, the bid is no longer valid. Purchasing must re-bid and go through the same process. At the performance level, Company X must first redesign its process for gaining signatures to reduce that to at least less than the length of the valid bid, more if possible. There is no training involved is this aspect, only a performance and systemic issue. Another issue that is impacted by delay in the purchasing process is that any tools that will be required to automate the system that will improve the speed to market will be outdated by the time it arrives as the tools change on a two-month upgrade cycle. Therefore, there is no advantage in sending employees to train on the tools.

Information Structure/ Objectives

After completing the Organizational Assessment, the model requires examining the findings and determining the structure of the information obtained. All information can be categorized into one of the following with any one issue involving the interaction of many:

- Principles – guiding forces such as vision, mission, ethics
- Concepts – ideas and definitions
- Processes – systematic ways work gets done
- Procedures – steps for completing a job or task contained in a process
- Facts – discrete pieces of information

Categorizing information in this way then permits moving forward to establish the objectives for the solution to an issue. Objectives are then arranged into a logical structure using the interconnections between pieces of information. Figure 2 is a worksheet to track the information derived from organizational assessment and form objectives.

Type of Information	Definition	Information From Analysis
Principle	Guiding forces such as vision, mission, and ethics.	
Concept	Ideas and Definitions	
Process	Systematic ways work gets done.	
Procedure	Steps for completing a job or task contained within a process	
Fact	Discrete pieces of information	

Figure 2 Information Structure/Objectives Worksheet

Media Analysis

Once content is defined and objectives are written, the delivery media can be determined. There are two major factors to consider:

1. Cost
2. Instructional/Student

All factors and considerations involving media are found in the Media Analysis Rating Scale tool, a sample of which appears in Figure 3. There is a Media Analysis Summary Sheet included with the tool to collect and analyze the data.

Media Analysis Rating Scale

Instructions

Complete the rating scale as follows:

1. Consider each factor on the rating scale as to its importance to the situation you are analyzing using the key provided.
2. Use the summary sheet to tally the number of occurrences of each media ranked as a 4 or 5.
3. Tally each media ranked as a 1 or 2. (Ignore those ranked as 3)
4. Subtract the number of Low Occurrences from the High Occurrences and record that number in the Difference column.
5. Determine the weight of the difference by comparing the difference with the All Occurrences column and record that percentage in the Weight column.
6. The media with the highest weighted average are probably the most likely media for your solution.

Rating Scale

5 = Very important consideration
4 = Important consideration
3 = Neutral consideration
2 - Unimportant consideration
1 = Not a consideration at all

Instructional/ Student Factors	Considerations	Suggested Media
1 2 3 4 5 Content requires interactivity (computer)	Does the content involve computer software, simulation or practice? Computer Based Training simulations can facilitate learning.	Computer-based Web-based
1 2 3 4 5 Content requires interactivity (human)	Will participants gain Interpersonal and communication skills from immediate feedback from an observer about their performance? To what extent does the learner need to use or demonstrate interpersonal or communication skills such as presentation, teamwork, leadership or facilitation?	Instructor-led Satellite broadcast Video teleconference
1 2 3 4 5 Audience has limited access to required expertise.	Is there limited expertise that must be leveraged across the organization?	Computer-based Satellite broadcast Video tapes Web-based Video teleconference
Instructional/ Student Factors	**Considerations**	**Suggested Media**
1 2 3 4 5 Students resistant to new media	How receptive is the audience to using a new medium? To what extent does attitude toward lecture style help or hinder learning? Note: Learners often enjoy LSI because it	Instructor-led

Instructional/ Student Factors	Considerations	Suggested Media
	allows them to be with other learners. Although they enjoy it, they may learn less. They may fear technology, have only experienced mainframe CBT, or do not want to spend more time at a computer screen. Take that fear into account and move toward a technology solution whenever possible.	
1 2 3 4 5 Employees must review the information frequently	Will reference materials be required? Is there a need for "look-up" capabilities?	Performance support Web based

Figure 3 Sample Factors from Media Analysis Tool

Do not consider the overall course or curriculum when applying the Media Analysis Rating Scale. Doing so will typically reveal that all media can be considered because, logically, all delivery media are potentially inherent in an issue of large scope.

Some description of each type of medium is required. Table 1 lists the types of media and an explanation of each. There are advantages and limitations of using each medium not covered here. These advantages and limitations should factor into the decision to use any particular medium.

Media	Description
Instructor-led	Materials intended to be presented by a teacher or facilitator. The materials may be presented in a traditional classroom setting or on the job. Presentations can include lecture, discussion, demonstrations, workshops, as well as other types of other media.
Computer-based	Any form of delivery involving the use of the computer. Options may include computer-assisted instruction (CAI), which includes other, printed and/or instructor materials; totally computer-based instruction, where all content is presented by the computer.
Distance broadcast	General term for category of instruction that is delivered over television, telephone, or via satellite to remote locations. Specific media are video and/or audio teleconferencing.
Web-based	Use of the internets or Intranets to distribute training over wide area networks (WAN) or local area networks (LAN).
Audio tapes	Use of pre-recorded audio tapes to deliver instruction with or without the use of supporting materials
Video tapes	Use of pre-recorded video to deliver instruction with or without the use of supporting materials
Performance support systems (PSS, EPSS)	Job aids, either electronic or paper-based, used to provide help and support to persons on the job. These do not require requiring any formal training or instruction other than on the use of the job aid tool.

Table 1 Types of Delivery Media

Once the most appropriate media are determined, each medium must be associated with an objective. This match determines how each piece of information will be delivered. For example, in the same issue you may have a systemic issue of communication. That portion of the solution will be delivered using a satellite broadcast. There may be a performance issue of providing the equipment to employees so they can get their jobs done. Employees will also need training on the equipment that will be delivered in a classroom setting.

Cost

Feasibility of each medium must be judged against the potential benefit offset by the cost of the solution. This is calculated through a Cost-Benefit Ratio. Cost equals the anticipated benefit of the solution compared to the investment required. The formula for Cost-Benefit is:

CB = Anticipated Benefit of the Solution ÷ Cost of Analysis, Design, Development, Implementation, Maintenance

The second element of Cost is the Internal Rate of Return. When a project begins, resources immediately begin to be expended. The question is, how quickly can those costs be recouped so that there will be a profit? The formula for Internal Rate of Return is:

IRR = Anticipated Benefit of the Solution ÷ Cost of Analysis, Design, Development, Implementation, Maintenance X Time

Both Cost-Benefit and Internal Rate of Return should be calculated before a project begins to determine if the project should be completed using the methodologies and media chosen.
The third element of Cost is Return On Investment. It is calculated at the completion of the implementation of the project to determine if the benefit was realized. The formula for Return on Investment is:

ROI = Actual Benefit of the Solution ÷ Cost of Analysis, Design, Development, Implementation, Maintenance

SUMMARY

The four components of the systematic approach described in this model will result in a business solution destined for success. Destined because all aspects of an issue are considered rather than only the narrow focus on one aspect. A systematic process uncovers and solves the true cause of the business issue rather than treating the symptom, as would examining only one aspect. As Gerry Rummler and Alan Brache state "If you pit a good performer against a bad system, the system will work almost every time." (pp.13)

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Tools for Online Interaction and Community Building

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Students are most critical of the lack of interaction when taking an online course. It is not enough to say that they will be satisfied with accessing a course online anytime and anywhere—for convenience sake. Students taking online courses desire the same levels of interaction they get in a traditional classroom. However, inherent to the online environment, face-to-face contact is lost and important community building opportunities. This does not mean that interaction, and the sense of community, has to be lost. The virtual classroom is still a community of instructors and learners. There are online instructional tools available that assist instructors in nurturing interaction and building community in the virtual classroom. We will showcase the eCollege.com tools that are effective for online interaction and community building.

Good teaching is good teaching.
We have to remember that--and repeat it over and over--in this day and age of distance learning, correspondence classes, and online environments. Even though the delivery systems for teaching are becoming more diverse, and sometimes more confusing, we must reiterate that the "classroom" is a community of learners. This community, though, whether in person or in cyberspace, has to be nurtured, and this nurturing takes the involvement of administrators, teachers, and students alike.

Evidence exists [name some here?] that establishing good administration in an online program translates to better informed and more enthusiastic teachers. This, in turn, leads to more satisfied students, who report learning more in an online class. [get research here?]

Laying the framework for a tight community (administration→teachers→students) of learners is important, especially when a school is in its infancy of an online program. With all of the other concerns involved with starting on online campus, nurturing a community may not be of the highest priority. However, this aspect is a vital component of that campus built in cyberspace.

Combining lecture and open discussion, we invite participants to engage in discussion and debate about the critical areas and suggestions for best practices and adaptation. The discussion will be enhanced by the multimedia presentation that visually constructs the circular progression of the online community as represented by the three critical areas of our discussion.

From Desktop to Webtop: Achieving True Computing Freedom, Anytime, Anywhere

Ken Rhie, ThinkFree, USA

This session will examine how the Internet has made dependency on operating system, location and computing device a thing of the past. The future: Internet solutions that are free to consumers with true anywhere, anytime computing -- offering support for any operating system, lowering the total cost of ownership and providing the autonomy to use different platforms interchangeably. New technologies that enable users to overcome the disadvantages and costs of using proprietary operating systems and applications will be explored. Applications that are optimized, from the ground-up, to unleash the true potential of the Internet, can complement shrink-wrapped software and provide alternatives to enable real mobility, flexibility and computing freedom.

E-Learning: A Strategic Weapon in the New Millennium

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Abstract: With the breakneck speed of today's business world, staying competitive and successful depends on the knowledge and education within companies. More and more companies are turning to education as a means to create a unified and successful working environment. Web-based learning allows businesses to maintain their momentum through offering flexible, timely options for workforces that must stay on top.

Attendees will learn:
1) How e-learning classes are faster to market with new technologies and trends than regular classroom training.
2) How web-based learning is especially suited to the many changes in the e-commerce marketplace today.
3) How e-learning adds to a company's bottom-line through return on investment and high performance employees.

Let Someone Else Do It Better: the New Wave Of Outsourcing

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Abstract: As the E-commerce space takes a new shape on a regular basis, companies are struggling to keep up with their IT demands. Outsourcing solutions removes the burden from a company's IT department.

Attendees will learn:

1) The benefits of outsourcing your solutions.
2) How outsourcing is suited to the many changes in the e-commerce marketplace today.
3) How outsourcing adds to a company's bottom-line through return on investment and high performance employees.

FULL PAPERS

The Influence of Learning Style Preferences on Student Success in Online vs. Face-to-Face Environments

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Abstract: This study compared the relationship between learning style preferences and learner success of students in an online course with an equivalent face-to-face course. Comparisons included motivation maintenance, task engagement, and cognitive controls. Results revealed significant relationships between preferences and course success on five constructs for the face-to-face students and no significant relationships for the online students. Overall, the findings suggest that students can be equally successful in face-to-face and online environments regardless of learning style preferences.

Introduction

New advances in Internet-based technology have brought challenges and opportunities to education and training, in particular through online instruction. While online instruction is gaining popularity, it is not free from criticism. Many educators and trainers are not advocates of online instruction because they do not believe it actually solves difficult teaching and learning problems (Conlon, 1997) while others are concerned about the many barriers that hinder effective online teaching and learning. These concerns include the changing nature of technology, the complexity of networked systems, the lack of stability in online learning environments, and the limited understanding of how much students and instructors need to know to successfully participate (Brandt, 1996). Online instruction also threatens to commercialize education, isolate students and faculty, and may reduce standards or even devalue university degrees (Gallick, 1998). Although the growth of online programs has been significant in recent years, the capabilities and efficacy of such programs have yet to be fully investigated. While researchers are viewing online instruction as a viable option for all types of learners (Hill, 1997), the issue of using learning styles research to create more positive, effective learning environments for all students is virtually unexplored.

Purpose

The primary purpose of this exploratory empirical study was to compare the relationship of learning style preferences and learning success for students enrolled in an online versus a traditional face-to-face course format. Comparisons included the environmental factors that maintain student motivation in the classroom, task engagement strategies, and cognitive processing habits (cognitive controls).

Research Questions

This study was designed to answer the following research questions.

1. Are there distinguishable differences in the learning style preferences of students enrolled in an online versus a face-to-face learning environment?
2. How do learning style preferences relate to the student outcomes achieved in online and face-to-face learning environments?

3. What learning style constructs significantly influence student outcomes in both the online and face-to-face delivery formats?

Theoretical Framework

Curry's (1991) Model of Learning Style Components and Effects served as the theoretical framework for the study which posits that motivation maintenance, task engagement and cognitive controls must be considered together. Motivational levels are maintained once the learner establishes preferred environmental and social conditions for learning. Task engagement level is reflected in the amount of attention that is paid to features in the instructional situation, how persistent the learner will be, the degree of participation, the enthusiasm, and degree of concentration the learner sustains throughout and beyond the instructional situation. Cognitive controls refer to the information processing habits or control systems that learners bring to learning situations.

Method

Instructional Context: Data were collected from two sections of a graduate level instructional design course for human resource development professionals. One version of the course was taught on the campus of a large Midwestern university through traditional a face-to-face format while the other version of the same course was offered totally online, with no direct face-to-face contact between the instructor and the students. Both courses were taught by the same instructor, delivered by the same department, and required the same content, activities, and projects. The instructional treatment of each topic followed the same organization.

Subjects: This exploratory empirical study compared outcome data obtained from students enrolled in one of two versions of a graduate level instructional design course for human resource development professionals. Nineteen students, most of whom are pursuing a graduate degree in HRD, were enrolled in the on-campus course. These students can be viewed as traditional university students who are actively pursuing an advanced degree through full time study on campus. Nineteen students were also enrolled in the online version of the course. These students are also pursuing a graduate degree in HRD through a degree program that is taught completely online. The online group can be viewed as nontraditional students because they are able to complete their advanced degree without ever setting foot on campus. The slight differences between the two groups in age, the year they received their baccalaureate degree, undergraduate GPA, years of work experience, and knowledge of instructional design were non-significant.

Instrumentation: The Grasha and Reichmann *Student Learning Style Scale* (Riechmann & Grasha, 1974) was used to assess motivation maintenance. The SLSS consists of 90 self-report items. A 5-point Likert-type scale describes the learner along the bipolar scale dimensions of independent vs. dependent, avoidant vs. participant, and collaborative vs. competitive. Task engagement was assessed by the Weinstein, Palmer, and Schulte (1987) *Learning and Study Strategies Inventory*. The LASSI contains 83 items. Subjects are asked to respond to the items on a five-point Likert scale. The items are sorted to ten variables including anxiety, attitude, concentration, information processing, motivation, scheduling, selecting the main idea, self-testing, study aides, and test strategies. Finally, cognitive control functions were assessed through the Kolb (1985) *Learning Style Inventory*. The LSI was developed around Kolb's experiential learning model. The LSI contains 12 sentence stems, each having four sub-items to be rank ordered. Responses are organized into two bipolar concepts: concrete experience vs. reflective observation, and abstract conceptualization vs. active experiementation.

Procedures: All date were collected near the end of the semester as part of a discussion and activity on learning styles. All students completed paper versions of all three instruments. The online students received and returned the instruments through the mail. The face-to-face students completed and returned their instruments during a class session. All instrument data were entered into a statistical analysis package for later analysis. Statistical analyses were conducted using independent t-tests and bivariate correlation analysis. All statistical tests reported in this paper were conducted with a significance level of .05. The search for distinguishable relationships in student outcomes (i.e., content knowledge and quality of course assignments and projects) across learning style preferences was conducted using a combination of performance indicators on class assignments collected during the course.

Results

Learning Style Differences: As shown in Table 1, the results of the independent t-tests indicate no significant differences in the social and environmental preferences between the students of the two delivery formats. Table 1 also reveals that both the face-to-face and online students are also comparable in their learning and study strategies with the exception of "study aids." This particular subscale assesses how effective students are at using support techniques and materials above and beyond those required by the course. This result indicates that the face-to-face students reports greater use of such techniques and materials (M = 30.17, SD = 4.76), t(34) = 4.10, $p < .05$. Finally, Table 3 reveals significant differences in the cognitive processing habits of the two student groups. Reflective observation measures the extent to which students learn by watching and doing. The mean difference on this subscale was significant (M = 30.53, SD = 8.57), t(35) = 2.18, $p < .05$, indicating that the face-to-face students are more reflective in comparison to their online counterparts. In addition, the face-to-face students report a higher degree of learning by thinking (abstract conceptualization) in comparison to the online students (M = 34.74, SD = 5.67), t(35) = 2.11, $p < .05$. Finally, significant differences were found on the active experimentation scale, which assesses the extent to which students learn by doing. In this case, the online students report greater use of this mode of learning (M = 36.11, SD = 8.46), t(35) = -2.54, $p < .05$.

Table 1: Learning Style Differences for Online versus a Face-to-Face Students

Learning Style Instrument	Face-to-Face*	Online*	t	p
Motivation Maintenance Subscales (SLSS)				
Independent	37.21 (3.55)	36.44 (4.90)	0.54	0.58
Dependent	36.79 (4.20)	36.11 (5.80)	0.40	0.68
Avoidant	21.00 (4.61)	23.06 (6.18)	- 1.15	0.25
Participant	41.84 (5.49)	38.89 (4.40)	1.18	0.24
Collaborative	40.58 (6.38)	38.50 (3.97)	1.18	0.24
Competitive	22.63 (5.98)	23.67 (7.40)	- 0.46	0.64
Task Engagement Subscales (LASSI)				
Attitude	35.00 (4.97)	35.00 (3.45)	0.00	1.00
Motivation	34.83 (3.93)	33.33 (4.83)	1.02	0.31
Time Management	30.50 (6.59)	26.83 (6.92)	1.62	0.11
Anxiety	29.89 (7.55)	31.72 (3.69)	0.92	0.36
Concentration	31.00 (4.64)	28.83 (5.75)	1.24	0.22
Information Processing	32.89 (4.78)	31.33 (4.87)	0.96	0.34
Selecting the Main Idea	21.33 (2.93)	20.89 (3.36)	0.42	0.67
Study Aids	30.17 (4.76)	23.78 (4.58)	4.10	0.00**
Self-Testing	29.39 (4.27)	26.94 (5.13)	1.55	0.12
Test Strategies	34.56 (3.81)	34.22 (4.53)	0.23	0.81
Cognitive Control Subscales (LSI)				
Concrete Experience	25.00 (6.19)	27.61 (8.12)	- 1.04	0.27
Reflective Observations	30.53 (8.57)	25.22 (5.88)	2.18	0.03**
Abstract Conceptualization	34.74 (5.67)	30.44 (6.67)	2.11	0.04**

Active Experimentation	29.16 (8.15)	36.11 (8.46)	- 2.54	0.01**

** significant at alpha = 0.05 (2-tailed)*

Learning Style Influence on Student Success: The primary question addressed by this study was to what extent were learning styles correlated to student success when the delivery format was controlled. The data were then analyzed using bivariate correlation analysis controlling for the delivery format. As shown in Table 2, a total of five significant correlations were found. For the maintenance motivation construct, as the level of avoidance of classroom activities decreased, the course performance increased. As student participation in classroom activities increased, the course performance increased. For the task engagement construct, positive correlations were found between attitude and course performance as well as time management and course performance. These correlations suggest that as student attitude becomes more positive and the use of time management techniques increase, course performance will increase. Finally, one negative correlation was found for the cognitive controls construct. As abstract conceptualization (learning by thinking) decreased, course performance increased. This particular finding is one that warrants further investigation.

Table 2: Relationship Between Learning Style Preferences and Success in a Face-to-Face Learning Environment

Learning Style Instrument	N	Mean	SD	r	p
Motivation Maintenance Subscales (SLSS)					
Independent	19	37.21	3.55	0.15	0.51
Dependent	19	36.79	4.20	0.19	0.43
Avoidant	19	21.00	4.61	- 0.58	0.00*
Participant	19	41.84	5.49	0.58	0.00*
Collaborative	19	40.58	6.38	0.09	0.69
Competitive	19	22.63	5.98	- 0.00	0.99
Task Engagement Subscales (LASSI)					
Attitude	18	35.00	4.97	0.51	0.02*
Motivation	18	34.83	3.93	0.43	0.07
Time Management	18	30.50	6.59	0.45	0.05*
Anxiety	18	29.89	7.55	0.19	0.44
Concentration	18	31.00	4.64	0.07	0.78
Information Processing	18	32.89	4.78	0.43	0.07
Selecting the Main Idea	18	21.33	2.93	0.26	0.28
Study Aids	18	30.17	4.76	0.32	0.18
Self-Testing	18	29.39	4.27	0.24	0.32
Test Strategies	18	34.56	3.81	0.40	0.09
Cognitive Control Subscales (LSI)					
Concrete Experience	19	25.00	6.19	- 0.25	0.29
Reflective Observations	19	30.53	8.57	0.31	0.19

Abstract Conceptualization	19	34.74	5.67	- 0.56	0.01*
Active Experimentation	19	29.16	8.15	- 0.18	0.44

**significant at alpha = 0.05 (2-tailed)*

The final analysis involved a comparison of learning style preferences and success in the online learning environment. The results from this analysis of the online students' performance showed no significant relationships between learning style preferences and course performance. These results are presented in Table 3. It is interesting to note that, while there was a significant difference between the online and face-to-face students in terms of cognitive control functions, it seemed to have little impact on course performance.

Table 3: Relationship Between Learning Style Preferences and Success in an Online Learning Environment

Learning Style Instrument	N	Mean	SD	r	p
Motivation Maintenance Subscales (SLSS)					
Independent	18	36.44	4.90	- 0.29	0.23
Dependent	18	36.11	5.80	0.29	0.24
Avoidant	18	23.06	6.18	- 0.03	0.88
Participant	18	39.89	4.40	- 0.02	0.91
Collaborative	18	38.50	3.97	- 0.10	0.68
Competitive	18	23.67	7.40	- 0.35	0.15
Task Engagement Subscales (LASSI)					
Attitude	18	35.00	3.45	0.21	0.38
Motivation	18	33.33	4.83	0.27	0.26
Time Management	18	26.83	6.92	0.06	0.80
Anxiety	18	31.72	3.69	0.05	0.82
Concentration	18	28.83	5.75	- 0.11	0.66
Information Processing	18	31.33	4.87	- 0.22	0.37
Selecting the Main Idea	18	20.89	3.36	- 0.18	0.47
Study Aids	18	23.78	4.58	- 0.07	0.76
Self-Testing	18	26.94	5.13	0.16	0.52
Test Strategies	18	34.22	4.53	0.02	0.90
Cognitive Control Subscales (LSI)					
Concrete Experience	18	27.61	8.12	- 0.00	0.97
Reflective Observations	18	25.22	5.88	0.20	0.41
Abstract Conceptualization	18	30.44	6.67	0.04	0.85
Active Experimentation	18	36.11	8.46	- 0.19	0.43

**significant at alpha = 0.05 (2-tailed)*

Discussion

Based on the results of the analyses, the following conclusions are made. First, even though there were learning style differences found between the face-to-face and online students, the differences were not highly apparent when the delivery format was controlled. Looking at the results from the correlation analysis for all students, motivation was the only variable found to influence course performance.

Second, the significant results from the correlation analyses for the face-to-face students also serves to reaffirm what we know contributes to positive learning outcomes for students. As student participation increased and avoidance decreased, performance was shown to increase. Positive attitudes and increased use of time management techniques influence course performance. The surprising correlation was the negative one that existed between abstract conceptualization (learning by thinking) and course grade. It may simply be that because the instructional design class was an application, hands-on course, success is highly dependent upon participation.

Finally, the most exciting finding from this study is the fact that correlations between learning style and course performance were not found for the online students. Consequently, this finding suggests that learners can be equally as successful in the online environment regardless of learning style. Granted, it does not mean that "anything goes" but that the online course must be developed well in order for learning to occur. This is true regardless of the format or content of any course. However, at a time when criticisms are still being made against the effectiveness and quality of online instruction, these findings from this study help to negate such statements.

Implications

The findings of this study show that online learning can be as effective as face-to-face learning in many respects in spite of the fact that students have different learning style preferences. In view of these findings, several implications emerge pertaining to future online program development. First, this analysis suggests that the development and use of online programs should continue. However, it is important that quality and thoroughness of the design and delivery be the catalyst for ensuring positive online learning experiences. Second, this study suggests that that a continued understanding of adult learning theory and learning styles needs to be emphasized among faculty. This is critical if courses are going to be designed to address the various domains of learning. This is especially critical in the online environment where an element of creativity is needed to identify and design educational experiences that can be as active, collaborative, and participatory as those commonly found in the face-to-face environment. Finally, educational practitioners should be aware of their own learning style preferences. Knowing our strengths and weaknesses as educators helps us to know where we will be strong and weak in terms of instructional design and delivery. Related to the second point above, designing online instruction that keeps students motivated and active requires thinking outside the box. Unless we know the boundaries of our "boxes," we run the risk of not incorporating all learning preferences found in our students.

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PhoneChannel: Using The Web and TV to Augment The Telephone

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Abstract: Communication and commerce by web or phone creates benefits and challenges for both buyer and seller. Websites provide convenience and visualization; telephones provide voice and real-time interaction. To combine these experiences, we developed PhoneChannel. Using PhoneChannel, a PC user while talking on the telephone can display visuals on the other person's television. How do these different media affect the shopping experience? In a recent laboratory study, prospective homebuyers selected houses of interest using web, telephone, or PhoneChannel. Using the telephone or PhoneChannel led to higher trust; but using web or PhoneChannel led to higher ratings on convenience, fun, and 'good method' scales.

Introduction

The rapid decrease in broadband multimedia costs coupled with increasing network flexibility has created new opportunities for residential communication and commerce. PC-enabled households have recently adopted email, pagers, chat and instant messaging as important communication media. The web is increasingly being used to initiate transactions, and email to provide customer care. However, the telephone has been the 20th century's paradigmatic device for interpersonal communication. Often, shoppers will locate an item (e.g., a plane reservation) online, but complete the transaction via phone.

Communication and commerce depend upon many factors including over-all value, efficiency, convenience, pleasure, and trust. In the absence of trust, commercial transactions require "formal rules and regulations, which have to be negotiated, agreed to, litigated, and enforced" (Fukuyama, 1995). Creating trust and loyalty is a challenge for telecommunication applications: In most web-based applications, the customer interacts with a web server and can easily view visual materials. Communication with humans is assumed and asynchronous at best.

On the other hand, most telephone-based transaction services (e.g., customer care or shopping from a catalog) either begin with real-time human interaction or allow call transfers for real time interaction. Telephones do not support real time sharing of visual information, and this can lead to difficulties in establishing common understanding; for example, a salesperson can have difficulty describing clothing, real estate, cars etc. and discussing its advantages. Do the visual and voice channels contribute differently to the commercial transaction? What are the most effective ways to use asymmetric and real time communication services? Can the web and phone experiences be improved?

Sharing Visuals during Conversations

Sharing visual artifacts, e.g., maps and drawings, has been shown to improve conversational efficiency and satisfaction (Whittaker, Brennan & Clark, 1991; Clark, 1993; Whittaker, Geelhoed, & Robinson, 1993). In fact, for communication efficiency it is more important than seeing the other participants. However, when the conversation is informal, personal, and emotion, call participants also like to see each other (Kraut & Fish, 1997). Apart from quality of service issues, a problem often noted by video telephony users is privacy (Webster, 1998). Given the emotional, social character of many household conversations, it is likely that video telephony in the household would be valued for intimate, emotional conversations, but also hampered by privacy concerns. In fact, privacy is an advertised virtue of web-based shopping.

The Telephone

To examine how to augment the telephone with a visual channel, it therefore makes sense to first examine how telephones are used in residential conversations. In its basic household form, the telephone is easy to use, and conversations are typically between two people. Telephones have evolved from a single appliance in a hallway, kitchen or living room to a personal and public appliance that can be found in almost any room in the house, e.g., bedrooms, family rooms, and kitchens. Extension lines and speakerphones allow conversations to include more than one household member. To maintain this social function, a visually enhanced telephone call should allow people in the same household to observe together in the same room or from several different rooms. Within a single call, the topic of discourse often shifts, earlier topics are reintroduced, and several topics can be discussed concurrently (Hopper, 1992). Therefore, if visuals are part of the conversation, it should be easy to change visual contents to reflect shifts in topic. Sometimes seeing the participant's face may be desired, and sometimes sharing a visual artifact, e.g., a map or a family photograph, may be useful.

Television

To understand the preferred uses of the visual component, it is useful to explore how other visual media are used. Television (TV) is probably the most widely used visual communication appliance. Like the telephone, it is easy to use. The channel tuner is the basic selection mechanism. Unlike the telephone, it provides a one-way communication channel. About two-thirds of the time people are doing other activities while watching television, e.g., talking on the telephone or web browsing (Clancy, 1994) and about 40% of the respondents report that the TV is left switched on most of the time (Lee & Lee, 1995). About two-thirds of prime time viewing is in a social context. Many people report that TV is a social experience, shared with others in the family, and even in isolation "... watching television takes on the characteristics of a ritualized visit with friends ..." (Lee & Lee, 1995). Its major benefit is undemanding entertainment, education (e.g., current events), and social participation.

Web Browsing and Chatting Online

Browsing the World Wide Web and interacting with others in chat rooms or through instant messaging have become popular forms of communication in Internet-enabled households. About two-thirds of those surveyed report that in addition to sending email and chatting, they very much want to share photographs (not necessarily of themselves) with friends and relatives (McAteer & Rubin, 1998). Similar to TV, the perceived benefits of the web, chat, email, and instant messaging include entertainment, information, and social participation (Flaherty, Pearce, Rubin, 1998).

Asymmetric Conversations

Given their widespread adoption and ease of operation, the combined use of telephones with televisions could provide a useful service. The difference in how these devices are used (active verses passive) suggests an asymmetric approach. One call participant (e.g., a bank loan manager) might control the display using an IP-device (e.g., a PC connected to the Internet) while the other participant (e.g., someone buying a house) simply views what is pushed on their cable TV. However, will such a service be effective? Would asymmetry in controlling the visual channel disrupt the social connection between participants? Could previously unknown customer services agents establish good social relationships with customers through asymmetric audiovisual connections?

Structural asymmetry, in which the properties of the media create the asymmetry, is infrequently investigated (but see Clark, 1993). Existing research tends to focus on remote business presentations (e.g., Isaacs, Morris, Rodriguez & Tang, 1995) where the audience can see the presenter but the presenter cannot see the audience. Asymmetry also exists in many face-to-face business presentations. There may be verbal interactivity during questions and answers, but the presenter controls what is displayed.

Implementing Asymmetric Conversations: PhoneChannel

We developed a new service, *PhoneChannel* that uses existing networks and devices. Rather than a single integrated device, PhoneChannel uses the telephone and television for one call participant and the telephone and PC for the other call participant. Instead of creating a network that integrates telephony and video, PhoneChannel loosely couples the Internet, the telephone, and the television networks. By loose coupling, we mean that they operate independently of one another but communicate status information to a shared database. The benefits of this are: (a) televisions and telephones are already present in many households in many countries, (b) loosely coupled networks can be developed more quickly and without costly new network infrastructure, and (c) minimal learning is needed because these everyday devices are used in a near normal manner.

Application Concept

PhoneChannel allows a person with access to the Internet to receive or originate a telephone call to a digital-cable subscriber and push visual material (the concept works equally well with broadband wireless and switched video over xDSL). The TV user can tune to a designated channel to view what was sent. For example, a young adult might call a grandparent, ask the grandparent to tune to channel "77", and display pictures of the newborn on the grandparent's TV. Likewise, a realtor could display houses to potential buyers (especially those moving great distances), or a user might call an interactive voice response system for tickets to a public event and view the possible seating arrangements. (Table 1) shows a possible call flow.

Table 1: A possible PhoneChannel call flow

What the users do	What happens in the telephone and cable networks
PC user or cable TV subscriber initiates a call.	Normal call set-up procedure.
The other person answers the telephone.	Normal telephone call connection is created.
At some point the PC user launches the PhoneChannel push application, and …	
… asks the TV subscriber to tune their TV to the PhoneChannel (a dedicated channel e.g. 77).	The cable network broadcasts the "on-hook" contents for that TV channel (the screen used when there is no call).
The PC user captures visual information with the PhoneChannel application using a "send" button.	The PhoneChannel server receives an instruction to display the designated data on the TV. The server uses telephony signaling or other means to confirm that the call is still connected.
On the television, the default image is replaced with the sent image.	The image is sent through the IP network to the cable head end with addressing information. It is converted into MPEG and sent to the appropriate set-top box.

Unlike screen phones, TV pictures can easily be viewed with other household members, and no new equipment is needed. Unlike web browsers, the other person sending the display finds the relevant material, while the TV user simply watches. In theory, PhoneChannel only requires one-way cable connections. Many concurrent PhoneChannel conversations can be supported multiplexing the visuals over a single channel. PhoneChannel can be delivered over two-way cable, and to other devices such as wireless handheld displays or household Internet appliances, e.g., a flat screen built into a refrigerator door (Michalski, 1997).

PhoneChannel uses the telephone number as the logical address of a visual display that is otherwise unassociated with the telephone network. Ideally, the telephone conversation is the authorization for the information "push". This combination has two important virtues: (a) It makes addressing the TV display easy for the sender, and (b) it prevents nuisance callers from displaying anything on a user's TV screen. Unless the TV user is willing to talk on the telephone and tunes the TV to the proper channel, the sender cannot display anything on the TV screen. When the call ends, the TV returns to the default contents.

Evaluating Phone Channel in an E-Commerce Application

Study participants pretended that they were relocating to New Jersey and selected one or more houses that they might like to see upon visiting. Questionnaires were given before and after the selection task.

Subjects

Fifty-nine participants were recruited in a mall intercept fashion at EPCOT Center in Lake Buena Vista, Florida. All participants in the study were between the ages of 18 and 55, were not residents of New Jersey, used the Internet four or more hours per week. All were planning to purchase a new home within the next 18 months. As an incentive to participate in the study, participants were given a calling card worth one hour of free long distance service. Thirty of the participants were women and 29 were men. Participants were permitted to have their partner assist them in answering questions if the partner was going to be involved in the decision to purchase the new home. Participants were assigned to one of three conditions (Web Only, Phone Alone, or Phone Channel) based on recruitment order. Twenty-one participants completed the Web Only condition, 20 completed the Phone Channel condition, and 18 completed the Phone Alone condition.

Procedure

After completing a set of questions on their current experiences and expectations of purchasing a new home, participants were asked to pretend that they worked for a large corporation that was relocating them to Monmouth County, New Jersey. Their task was to select one or more houses with a price range between $275,000 and $325,000 that they would like the realtor to show them when they visit New Jersey.

For the Web Only condition, participants were seated in front of a personal computer to select houses from a real estate web site. For the Phone Only and Phone Channel conditions, participants sat on a couch approximately nine feet from a 27-inch color television. In front of the couch there was a coffee table, a telephone, and a remote control for the television. For the Phone Only condition, participants were instructed to call the realtor and to work with him to select one or more houses that they would like to see when they visit New Jersey. For the Phone Channel condition, participants were instructed to call the realtor, and to tune into the Phone Channel on the television. For both of these conditions, participants communicated with the realtor using a speakerphone that allowed the experimenter to listen to the conversation.

The realtor in this study was a licensed real estate broker located in New Jersey. The realtor was paid for his service and was trained on how to use the Phone Channel. The real estate broker was instructed to treat the participants in a manner identical to any customer that contacted him for help in selecting houses. The realtor had access to the same real estate web site that participants had in the Web Only condition. In the Phone Channel condition, the realtor could display any information that was on the web site to the television that participants viewed in the laboratory. Experimental sessions lasted approximately 30 to 40 minutes with the experiential portion of the session lasting approximately 15 minutes. A questionnaire was administered following the experimental procedures.

Results

The purpose of this research was to examine differences between phone-only, web-only, and PhoneChannel method. Therefore, for brevity only results relevant to these differences will be discussed.

Performance Results

Participants in the web only condition selected 3.2 houses, on average, while participants in the phone only condition selected 2.3 houses and those using PhoneChannel selected 2.2 houses. An ANOVA on this performance data indicated main effects due to method, $F(2,52) = 4.2$, $p < .05$. A Scheffe test on the three methods indicated that participants in the web-only condition generated significantly more houses selected for future viewing than those in the other two methods, $p < .05$ in both comparisons. Method did not interact with the other factors but there were main effects due to age and gender. Women tended to select more homes than men (2.7 vs. 2.1 houses, $p < .05$) and younger participants tended to select more houses than older participants (2.7 vs. 2.1 houses, $p < .05$).

User Judgments

Each subject answered 20 questions using a five or seven point and one yes/no question. The yes/no question, "Would you recommend this method?", revealed no differences between the three conditions. The main effects of communication method, age, gender, IP use, and Phone on the remaining twenty questions were analyzed using the Wilk's lambda MANOVA. Of the four factors, only communication method was significant, $F(40, 66) = 2.83$, lambda= 0.1356, $p < 0.001$. Furthermore, the communication method exerted a significant affect ($p < .05$) on eleven of the twenty questions. A principal components analysis and varimax rotation using the responses to these eleven questions produced a three-component solution, which accounted for 74% of the variance. The first component appears to be related to attunement, trust, and other interpersonal relationships. The second component is comprised

Table 2: Average scores for the three constructs by method of communication (1 to 5 scale, where 5 is highest)			
Constructs	**Method of Communication**		
	PhoneChannel	**Web only**	**Phone only**
Interpersonal Trust & Attunement (5 items)	4.0	3.2	3.8
Task Satisfaction (4 items)	4.4	4.5	3.8
Face to face substitute (single item)	3.8	2.9	2.5
Comprehensive	3.6	4.2	3.5

of questions related to whether or not the methods were satisfying, and more specifically, "fun", "good method", "comprehensive" and "convenient". These appear to be the personal benefits of using the communication method, as opposed to the interpersonal benefits included in the first component. The third component was more difficult to interpret, but loads most heavily on the extent to which the communication method could substitute for an initial face-to-face meeting.

Averaging the scores to the questions that align best with one of the three principle components yields the constructs and scores in (Table 2), and accounts for ten of the eleven significant variables. A MANOVA test of the effect of communication method on these three constructs was significant, F(6,108)= 11.5, lambda=0.37, $p < .00001$. Scheffe tests indicated that both PhoneChannel and Phone lead to significantly higher responses on questions concerning trust and attunement ($p < .05$). In addition, PhoneChannel and Web were significantly superior when rated on questions involving task satisfaction ($p < .05$), e.g., "fun", "good method", "comprehensive" and "convenient". PhoneChannel scored significantly higher than Phone ($p < .05$) and marginally higher than Web ($p < .07$) when rated as an acceptable substitute to an initial face-to-face meeting.

Although it did not produce significant differences among the three methods, it should be noted that responses to the question " I felt in control using this method of selecting houses" yielded average scores of 4.0, 4.1, and 3.5 for PhoneChannel, Web, and Phone methods. Thus, within the context of these laboratory procedure and measurements, participants felt no lack of control when using PhoneChannel relative to using the web. The Web was considered marginally more comprehensive than the other two methods ($p < .10$).

Conclusions

PhoneChannel creates a loose coupling between otherwise independent communication media and uses the address space of one media as an alias address for the other media. In its one-way configuration, it also creates asymmetries in control and visualization. Our study of the real estate application indicates that this form of asymmetry does not interfere with feelings of control, overall satisfaction, and the formation of trust. Indeed PhoneChannel led to high levels of trust and task satisfaction. Notably, auditory information and/or real time interaction seems to produce higher levels of trust and attunement, and visual information supports higher levels of task satisfaction.

PhoneChannel provides many benefits that can be provided by screen phones and two-way video telephones. However the PhoneChannel concept offers distinct advantages, especially for residential applications:

(1) Televisions and telephones are ubiquitous and easy to use. PhoneChannel does not alter the user interface of these devices, and they can be independently upgraded. This is consistent with our belief that familiar devices should be used in familiar ways.

(2) Television viewing is a relatively relaxed but often social activity. Telephone conversations are highly social activities, and sometimes involve more than one household member. PhoneChannel permits flexibility; the visual display could be directed to a public television or a television in a private space, e.g., a bedroom.

(3) The audio network (i.e., the public switched telephone network) and the visual network (i.e., the television broadcasting system) remain independent and can be independently evolved. Thus, the evolution from switched telephony to Internet telephony does not alter the PhoneChannel application.

PhoneChannel provides a means by which non-PC households could communicate with PC-enabled households, while minimizing device complexity for the non-PC user. Even in PC-enabled households, PhoneChannel via television may be desired because PCs are often situated on desktops away from the social center of the household. While our real estate study focuses on asymmetric communications within the home, the PhoneChannel service is not limited to use in the home or to communication through telephones and televisions. In fact, the current prototypes readily support PC-to-PC applications, and can also be extended to communications with mobile devices. The results presented above should generalize to all of these variations.

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Effect of Streaming Video on the Decision Maker as Measured by the Analytic Hierarchy Process: An E-Commerce Case

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Abstract: This paper describes a research project that is investigating the effect of the inclusion of visual cues on the consistency of the decision making process as it applies to consumer purchasing decisions in e-commerce applications. This research is investigating the sensitivity of consistency as measured by the Analytic Hierarchy Process (AHP) when visual cues are incorporated. An experiment has been designed in an application area of e-commerce. The research design includes the development of a hierarchical representation of the factors that affect the decision-maker when interacting with traditional e-commerce applications. The control group used still images and the experimental group used streaming video to compare different products. Statistical analysis techniques will be used to measure whether or not the inclusion of specific types of visual cues significantly improve the consistency of the decision maker for the research problem selected. It is expected that the results of this research will provide some insight into the effectiveness of the inclusion of visual cues via the use of streaming video in the design of web applications for e-commerce.

Introduction

E-commerce is becoming an integral part of today's business world. Essentially, e-commerce is using electronic means to facilitate the buying and selling of goods and services over the Internet. Dillon [1999] reports that worldwide e-commerce revenue will grow from $98.4 billion in 1999 to $1.2 trillion in the next four years and that the United States will continue to generate a majority of the dollars produced. As the use of e-commerce becomes more prevalent in today's business market, it will be necessary for firms to develop e-commerce sites that both attract and maintain their customer base in order to remain competitive.

Developers of e-commerce sites need to have an understanding of design issues that enable customers to effectively use their site. The field within computer science that addresses user interface design is Human Computer Interaction (HCI). The study of HCI has contributed substantially to the body of knowledge of how humans interact with computers. The results of such study have enabled the developers of computer systems to deliver products that are usable and that effectively support the user community.

Literature review reveals that very little research has been done in the area of Human Computer Interaction as it pertains to the design of e-commerce applications. As a matter of fact, according to Dave Stolzfus (1999), a high percentage of customers find the online customer experience so poor that they just quit. The fact that so many customers leave the site in frustration without purchasing any products is an indication that help is needed in designing usable interfaces. In order to increase the site's usability, user interface designers need guidance in developing the interface from the users' perspective. Therefore, research is needed to provide necessary answers and guidance to these interface designers who are trying to develop effective e-commerce sites. In the current business environment, these sites will be a determinant of the company's ability to remain competitive.

Significance of Research

As developers attempt to create sites that will be attractive to customers, they often incorporate leading edge technological elements that stretch capabilities of existing software, hardware and networks. These elements utilize extensive resources and are expensive in terms of equipment, time, money and people. Resource management and effective user interface design are critical elements in the deployment of successful e-commerce sites. Therefore, adequate research of such elements is needed to justify their inclusion and to provide insight regarding their use.

Currently one of the newer technological elements in the World Wide Web (WWW) is streaming video. Research is needed to determine whether the use of streaming video instead of still images in an e-commerce application makes any difference in the purchasing decisions of the customer. One way to assess the impact of this technology is to study the consistency of the decisions made by the e-commerce customer when the technology is incorporated within the site. Results of such a study could provide information that will assist interface designers in creating cost-effective e-commerce sites.

Objectives

The main objective of this research is to investigate the effect of the inclusion of visual cues on the consistency of the decision making process. This research is attempting to determine the sensitivity of consistency to visualization provided by streaming video in the process of decision making by the user of an e-commerce site. In addition, the findings of this study will provide information that should be useful in formulating e-commerce interface guidelines.

Methodology

Step 1: Design an experiment to measure the impact of different types of visual cues on the consistency of the decision-maker.

The design of the experiment included the selection of a real world purchasing problem; the design of a tool that allowed the display of the visual cues under investigation; the design of a transparent way to collect data from the subjects; and the determination of the sample population.

The experiment needed to have a real world problem that required the user to make a purchasing decision. The product being purchased needed to be one that could be advertised and sold at e-commerce sites as well as being of sufficient significance to the customer that s/he would consciously make a decision regarding its purchase. For example, a product that meets these criteria is a car. The decision regarding the purchase of a car involves the consideration of several factors such as comfort, fuel economy, style, price and reliability.

The tool designed is a web-based application that serves two purposes. The first purpose is to make available a well designed e-commerce site for buying cars that exhibits the visual cues under investigation. The second is to provide capabilities that support the research effort by tracking the user interaction as a purchase decision is made.

A convenience sample from a Midwestern University was used for the experiment. This sample consisted of students, faculty and staff that agreed to participate in the research.

Step 2: Selection of a reliable method to measure the consistency of the decision-maker.

Decision making in a complex problem generally involves evaluating multiple criteria simultaneously and implies selection of a choice among alternatives. These criteria or attributes are the factors that describe the alternatives and measure their effectiveness in fulfilling the objectives. Often these criteria conflict with each other; and in addition, these criteria may be qualitative or quantitative in nature. Hence, a decision making methodology is required that incorporates both subjective and objective evaluation measures in the analysis of a problem. The Analytic Hierarchy Process (AHP) is a technique for dealing with problems which require evaluation of multiple criteria simultaneously.

The mathematician and management scientist, Dr. Thomas L. Saaty developed the Analytic Hierarchy Process. The process has been studied extensively by other researchers and has been determined to be logically and mathematically sound. AHP is based on the principle that to make decisions, a person's experience and knowledge are as valuable as the data used (Saaty and Vargas, 1982).

AHP has been investigated and used in Decision Support Systems (DSS). It is a systematic procedure for representing the elements of any problem in a hierarchical fashion. AHP breaks down a complex problem into a small number of constituent elements and arranges these elements in a simple hierarchical structure. The top level of the hierarchy is the goal to be achieved in the decision problem, the middle levels contain the criteria that affect the goal and the bottom level consists of the alternatives which are to be evaluated in terms of the criteria in the upper levels. It then calls for pairwise comparisons between the elements of the same level with respect to each of the elements in the level above. These judgments, carried out through pairwise comparisons, are assigned numerical values. These values are stored in matrices and evaluated to determine the priorities of the elements. All these priority values are then aggregated to produce the rating of the decision alternatives. The hierarchical structuring used in this technique is based on the relationship between the elements on subsequent levels.

AHP presents a unique feature, the consistency ratio, to measure the consistency in decision making. A decision-maker needs to be aware of any inconsistency involved in solving a problem since the lack of consistency affects the validity of the decision.

The structuring of the hierarchy is crucial in that it should represent the problem as thoroughly as possible, but not be so inflexible as to lose sensitivity to change in the elements. The hierarchy model should identify the issues that affect the solution (Saaty, 1990). The judgments expressed in terms of pairwise comparisons depict the relative importance of one item versus another in meeting a goal. Each of the pairwise comparisons denotes an estimate of the ratio of the weights of the two criteria being compared. The synthesizing of the priorities requires the matrix manipulation to generate an eigen vector corresponding to the maximum eigen value. The eigen vector used in the AHP facilitates the analysis of the consistency of the pairwise comparisons thus providing a way to measure the degree to which the decision-maker's judgments are consistent.

Step 3: Implement an experimental e-commerce site that exhibits the visual cues to be tested.

The purpose of this research is to investigate the effect of visualization provided by different types of visual cues on the consistency of the decision-maker. In particular, the investigation is attempting to determine if the consistency of the decision-maker is affected by using streaming video rather than still images as the type of visual cue provided in an e-commerce site. Thus, in this study, it was important to develop an e-commerce site that incorporated a situation for a customer to utilize either streaming video or still images as visual cues in making a decision. The selection of appropriate elements within the AHP hierarchical model was an important aspect of the research since the result's accuracy depends on this design.

In order to carry out the research, a multimedia web-based e-commerce site to support the experiment was designed, developed and implemented. The interface for this tool provided information in the form of streaming video or still images. It also provided the user with the capability to select choices from each pairwise comparison and navigate intuitively within the site.

Java Servlets were used in the construction of the site. In addition, Real Producer and image processing tools were used to construct the visual elements required for the experiment.

Step 4: Conduct an experiment to measure the impact of different types of visual cues on the consistency of the decision-maker.

After developing and pilot testing the proposed site, the experiment is being conducted. The first step was to recruit suitable subjects to perform the evaluation of the criteria. A convenience sample was selected.

The control group interacted with the application using only still images; whereas, the experimental group utilized streaming video. The application program collected the responses for each of the pairwise comparisons. A utility program has been written to calculate the priority vector, consistency index and consistency ratio for each matrix as well as the overall priority for each hierarchy.

Statistical analysis techniques will be used to measure whether or not the inclusion of specific types of visual cues significantly improve the consistency of the decision maker for the research problem selected. The data that will be used for this analysis are overall consistency ratio, overall priority vector of the hierarchy, and priority vector of the criteria evaluation matrix of both control and experimental groups.

Step 5: Formulate user interface guidelines based on the findings of this research.

In this step, the results will be analyzed and relevant guidelines developed.

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Utilizing Interactive Instructional Strategies to Improve Teaching and Learning in Web-assisted Courses

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Abstract : While the World Wide Web holds the potential to improve teaching and learning, this potential is not being fully realized by many educators now integrating Web technologies in their classroom-based courses. The purpose of this paper is to provide these educators with some ideas on how to utilize the interactive components of the Web to improve teaching and learning.

Introduction

Over the past few years a growing number of educators have begun to incorporate the World Wide Web in their classroom-based courses. The World Lecture Hall, a site that contains a directory of Web-assisted courses, has links to over 2000 courses in 92 categories from accounting to zoology. While some of this growth can be attributed to university mandates, such as UCLA's "Instructional Enhancement Initiative," that require the use of computer technology in the delivery of higher education, it is more likely that the growth is a consequence of more educators accepting claims about the Web's potential to improve the teaching/learning process.

The Web's potential to improve the teaching/learning process lies in its ability to enable educators to collect feedback from students which can be used to monitor student progress, control the pace of learning and evaluate teaching strategies. However, an analysis of a random sample of 200 Web-assisted courses posted on the World Lecture Hall, reveals that many educators choose to use the Web primarily for distributing static documents. Of the courses surveyed, approximately 64 % offered students little more than basic course information such as syllabus, assignment schedule, announcements, reading lists, and, occasionally, an obligatory link to the instructor's email address with no reference made as to how it was to be used. At the few sites that did refer to the email link, the reference was usually in the form of a warning about how the link was NOT to be used. Thus, while the Web does hold the potential to improve teaching and learning, this potential is not being fully realized by many educators now integrating Web technologies in their classroom-based courses. The purpose of this paper is to provide these educators with some ideas on how to utilize the interactive components of the Web to improve teaching and learning.

Interactivity and Feedback

According to Chickering and Ehrmann (1996), when searching for technologies to enhance communications in a classroom-based course, educators should eschew materials that are didactic and search instead for technology-assisted solutions that are interactive and evoke student motivation. Salomon (1993) and Schrage (1990) explicate that interactive or cooperative learning communities provide a richer environment in which to share ideas and engage in learning, than do more didactic instructional environments. Using communication technologies that increase access to faculty members, help them share useful resources, and provide for joint problem solving and shared learning can usefully augment face-to-face contact in the classroom (Chickering and Ehrmann 1996). These technologies can strengthen faculty interactions with all students, but particularly with those who are hesitant to participate in traditional classroom discussions (Partee 1996; Owen 1993). It is often easier for these students to discuss values and personal concerns in writing than orally, since inadvertent or ambiguous nonverbal signals are not so dominant (Chickering and Ehrmann 1996). The result is communication that is more intimate, protected, and convenient for the student than the more intimidating demands of face-to-face communication with their teachers.

Because Web technologies can be used to foster various types of interaction, they support the development of constructivist learning environments. In designing learning environments, researchers (Honebein 1996; Lebow 1993; Knuth and Cunningham 1993) have advocated using constructivist theory for effective learning. Constructivism incorporates pedagogical goals in the knowledge construction process by providing appreciation for multiple perspectives, encouraging self awareness of the knowledge construction process, situating learning in relevant contexts, encouraging ownership in the learning process, embedding learning in social experience, and encouraging multiple models of representation (Vygotsky 1986; Bruner 1990).

By using the interactive components of the World Wide Web, educators are able to utilize several interactive instructional strategies that can facilitate the development of intellectually motivated students (Rasmussen and Northrup 1999). These interactive components of the Web can help engage students in active application of knowledge, principles and values, and provide them with feedback that allows their understanding to grow and evolve (Hazari and Schnorr 1999). This interaction can with content, other students, or the instructor. Researchers such as Gagne, Briggs and Wager (1988) have stressed the importance of evaluating students' understanding, providing feedback during evaluation, and assessing complete understanding of each concept as part of the effective learning process. Moore and Kearsley (1996) and Cornell and Martin (1997) have specifically identified interaction and feedback components as factors that influence student motivation in completing a course.

The author has successfully used the interactive instructional strategies presented in the following section over the past two years in three Web-assisted courses. The underlying purpose of the strategies was to facilitate student interaction with course content, peers, and the instructor. While used in undergraduate business courses, the strategies are general enough to have applicability in any classroom-based course.

Interactive Instructional Strategies

Several strategies were used to facilitate student-to-content interaction. For each course, a comprehensive Web site was created to facilitate access to all course materials such as the course syllabus, class assignments, review exams, assignment schedule, PowerPoint ® presentations and lecture notes. To introduce students to the potential of the Internet as an information source and to encourage them to use it as a research tool, links to external resources were provided in many of these Web documents. For example, the lecture notes include links to Web sites containing additional information on topics covered in the notes, the syllabus has links to the online publications used in the course and the class assignments have links to Web sites with information pertinent to the assignments. In addition, a directory of Web sites with information relevant to the course is maintained on each course's Web site as is a directory of Web sites offering guides designed to be helpful to students. These include guides on writing a research paper, developing a marketing plan, creating an advertising campaign, giving a formal presentation, etc. Also, students were offered extra credit to seek out Web sites related to the course and post a link to the site, along with a brief description, to the class bulletin board.

Critical to fostering student-to-content in a Web-assisted course is the design of the Web site. The Web pages were aesthetically pleasing and appropriate for the learning situation and followed appropriate screen design/layout principles. For example, each page was no more than 3 – 4 screens long to avoid excessive scrolling. Graphics were used sparingly to ensure that pages downloaded quickly. Links to outside sources were tested frequently. Pages shared the same basic layout grids, graphic themes, editorial conventions, and organizational hierarchies to ensure design consistency. And the site was kept flat in order to avoid having to make several clicks to get to a particular page.

To encourage student-to-student interaction outside the classroom, an electronic bulletin board was used in each course. On a weekly basis, the students are required to post to the electronic bulletin board responses to questions from assigned readings and to respond to at least two of the postings of their peers. These bulletin board assignments are meant to augment in-class discussions and to improve the students' written communication skills. Requiring students to participate in an online discussion has been found to improve their ability to write coherently (Karayan and Crowe, 1997). In the process of contributing to the online discussion, students are using a mode of expression that is a form of writing: composing their ideas at the keyboard, editing their comments, and then "publishing" their comments to the class bulletin board. Their peers then provide feedback, commenting on the quality of the message, objecting to the ideas expressed, asking for clarification, and so on. This public nature of the writing and public exchange of ideas causes students to take their work more seriously. They make a greater effort to ensure that their messages are clearly conveyed and that their claims are adequately substantiated. They also begin to take pride in writing well, especially when others commend them on what they have written. By participating in an online forum, students learn how to think through ideas, how to anticipate and respond to objections, and how to express themselves with clarity and power all of which improves the quality of the responses to the discussion (Karayan and Crowe, 1997). It also provides a means of participation for those students who are reluctant to participate in traditional class discussions (Partee, 1996). It is often easier for these students to discuss values and personal concerns in writing than orally, since inadvertent or ambiguous nonverbal signals are not so dominant (Chickering and Ehrmann, 1996)

The course Web site was used as part of the peer review process for term papers. Each student was encouraged to submit a draft of his or her term paper as an HTML document that was uploaded to the class Web site for review by his or her peers. Students who agreed to participate in the peer review process by publishing their papers on the Web were awarded extra credit.

In order to facilitate online communication on a one-to-one basis, a directory of student e-mail addresses was maintained on each course's Web site. If a student wanted to send an email message to another student, he/she only had to access the Web page with the class e-mail directory rather than search for that student's email address.

Increasing opportunities for students to work together increases their involvement in learning. As Chickering and Ehrman (1996) note, being able to work collaboratively with one's peers improves thinking and deepens understanding. It also allows students a more real-world experience that contributes to an enhanced educational setting (Hunter, 1990).

Perhaps the most significant advantage of using the Web in a classroom-based course lies in its potential to enable instructors to develop one-to-one relationships with their students that may not be possible in a traditional course. Developing this one-to-one relationship is critical in assessing the effectiveness of the learning environment in meeting learning outcomes (Riel and Harasim 1994). Consequently, several strategies were used to encourage and facilitate student-to-instructor interaction. One simple but highly effective strategy was to provide a link to the instructor's e-mail address on all online documents like the course syllabus, lecture notes, class assignments, and review exams. To encourage students to use this link, all email messages were answered promptly (usually within a 24 hour time period).

In each course, a HTML form was used collect student feedback during the course on teaching effectiveness, clarity of course content, appropriateness of assignments, as well as the content, format and design of the course Web site. In order to motivate the students to provide feedback and to ensure that they were forthright when doing so, the form was designed so that it could be submitted anonymously. Lauzon (1992) has found that providing a measure of anonymity in online discussions empowers students and causes them to be more forthright in expressing their opinions. To facilitate access to the form and encourage students to use it on a regular basis, the form was included on the menu made available on every page of the course Web site. Moore and Kearsley (1996) state that evaluation should be a continuous process and effectiveness of materials and media should be routinely assessed.

A formative evaluation is well suited in a Web-based environment because of the advantage of instructor intervention in a timely manner. By collecting formative data during the course, the instructor can more readily identify and take corrective action on issues that affect learning. Furthermore, by cooperating in assessment, students reinforce their grasp of course content and strengthen their own skills at self-assessment (Angelo and Cross 1993).

An HTML form was also used at the beginning of each course in order to assess the initial competencies of the students. An email message was sent to all students pre-enrolled in the course requesting them to complete the needs assessment form no later than the end of the first week of classes. This form requested feedback on each student's educational background, computer competencies and special learning needs. The data were used to structure the course to fit better fit the needs of the students. For example, if the data revealed that few students were familiar with the Internet technology used in the course, part of a class session would be devoted to a discussion and demonstration of this technology.

Conclusion

Since its emergence in the early 90s, the World Wide Web has had a substantial impact on education. Indeed, some educators have argued that the introduction of the Internet technologies such as the Web have caused a paradigm shift in the field of education; the rejection of one set of values and ideas about education and the adoption of a new set with regards to what constitutes effective pedagogy (Roberts 1997). University and college administrators exhort their faculty to integrate the Web into lecture-based and other types of academic courses. As students' competencies with Internet usage increase they, too, place pressure on educators to revise their educational methods. Unfortunately, those faculty desiring or being exhorted to move toward technology-mediated instruction are not always given sufficient guidance on how this should be done. Consequently, many respond by either disdaining technology and holding steadfastly to the status quo or, worse, using a haphazard approach in incorporating technology in their teaching without any real understanding of its pedagogical value. What they and others sometimes fail to realize is that while the Internet *is* a significant tool with which to enhance the teaching/learning process, *effective use* requires careful consideration (McManus 1996).

This paper has offered some interactive instructional strategies to those educators seeking ways to more effectively utilize Web-based technologies in the classroom-based courses. The strategies recognize that the key to effectively using World Wide Web in any course, is to fully exploit the interactive properties of this new medium. Otherwise, educators will continue to struggle in their efforts to use Web technologies to enhance learning and to meet instructional objectives and the trend toward the greater use of technology in education will be seen not as a progressive trend but as a regressive one.

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Instructional Design Attributes of Web-Based Courses

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Abstract: Revitalized efforts have taken place in the fields of knowledge engineering, expert systems, and multimedia educational technology. The delivery of instruction and instructional materials changed from instructor to students in a classroom, to learners in a certain country or even to students all over the world on the Web. What theory or model can educators follow to design effective instruction for distance learners on the Web? In an effort to apply traditional instructional design theories to Web course development, the researcher conducted a qualitative research study to examine the experiences in Web course design and delivery and to explore what components affected Web-based course design. The purpose of this research study is to identify and document instructional design attributes of the Web courses which contribute to the comprehension of online instruction and the relationships between these major areas in Web-based courses: Instructional design, course development, content delivery, and administrative support.

Introduction

University campuses are changing because of the alternating demographics of their student bodies. The archetypal 18-to-22-year-old undergraduate going through school in four consecutive years and financed by parents is becoming increasingly rare and unconventional. People are taking up their degrees later and over longer periods, assembling them out of one course here and a few credit hours there, snatched between jobs and bank loans, as time, money, interest, and opportunity arise (Brown and Duquid, 1996). Brown and Duquid continued by saying that it is not technology that will cause the changes in the way higher education degrees are offered but rather technology will be very important in the accommodation of an already changing system.

Educational technology in the nineties is a dynamic emerging field. Electronic teaching and learning on the Web are attracting more and more attention from all walks of life. With the help of telephones, fax, computers and Internet, the explosion of information technology has caused the present age to be one of instant communication. Time and distance have been spanned by satellite communications, telelinks and the electronic transmission of texts and images. Information, and the ability to transmit, receive and process it, is increasing rapidly, as are new teaching and learning technologies (UNESCO Principal Regional Office for Asia and the Pacific, 1988).

Three years ago, as an Electronic Instructional Design Specialist, the researcher was designing and editing Web courses for the program of lifelong learning at Ohio University. In an effort to contribute to the knowledge based for creating web-based instruction and as the fulfillment of the Ph.D. program, the researcher conducted a qualitative research study to examine the experiences of faculty, distance learners, instructional designers/developers and distance program administrators in Web course design and delivery. And from their experiences at three sample institutions of higher education, the researcher planned to explore what components affected Web-based course design. This research study investigated and described the relationships between these major areas in Web-based courses: instructional design, course development, course delivery and administrative support.

The purpose of this research study is to identify and document instructional design attributes of Web-bases courses, which contribute to our understanding of how to teach online and how to assist distance students learn from the online courses. Consequently from the findings of this study, educators may rethink the process of instructional design, which comes from the traditional instructional design models and theories, but accustoms new features of Web-based courses. Another purpose is to acquire an in-depth understanding about the Web as a mode of delivery in distance education and its effects on distance learning. The research is guided by, but not limited to the following broad themes identified in a review of literature: instructional systematic design, and teaching and learning on the Web. Besides studying these selected broad themes, this study also explores problems and prospects of online instruction/Web-based learning, which have emerged from the interviews conducted, and the instructional materials examined during the sixteen-month fieldwork.

The Research Study

This qualitative research study included data collection and analysis. Data collection consisted of the multiple sources of data: (1) people; (2) Web sites and instructional materials both print and online; (3) interaction created with online communication tools and required by instructors/professors as well as multimedia technologies used for convey of the course content. The researcher collected data through analysis of course materials, interviews with the faculty, instructional designers, administrators and distant learners from these institutions, and analysis of online instructional activities. All data came from three different settings:

(1) A state university in the Midwest, whose institutional focus is primarily on traditional teaching, has been offering course by correspondence for years and is new in delivering web courses
(2) A state college in the north, whose institutional focus is primarily on distance education, has three years of experience offering web courses; and
(3) A university in the northwest, whose institutional focus is primarily on virtual distance learning, has offered online courses for more than three years.

The researcher contacted the faculty, instructional designers and administrators first. And then according to their willingness, she chose them as interviewees. The participants from the three colleges/universities were ten faculty members who taught courses on the web. Among them two are professors; two are associate professors, three assistant professors, and three instructors. Seven instructional designers or web developers participated the interview - all are full time for online course development, three of them are part-time online course instructors as well. Three distance education program administrators also shared their insight with the researcher in web-based courses management and administrative issues. Since most interviewees from three institutions are located in different states of the country, the researcher interviewed them by email first, and followed up with phone conversations.

Faculty members recommended 32 distance students to the researcher as interviewees. A letter introducing the study and asking for volunteers was sent to these distance students, who were taking the Web courses at the time. The researcher explained to them the purpose and procedures of the study. After these students responded for consent to participation, the researcher emailed the interview questions to all of them. 24 distance students answered the interview questions, talked on the phone or by email messages for follow-up inquiry, and finished the entire interview procedure.

The researcher analyzed three Web-course sites from each college/university. The researcher examined the instructional materials, i.e. course syllabus, online study guides, quiz/test, links to other sites, and other media such as: floppy disc, CD-ROM, videotape, and supplementary printed materials. She also analyzed the opportunities for interaction between student and materials (online, floppy disc, etc); between student and instructor (e-mail, Listserv, Bulletin Board, Chatroom, etc); between student and student (e-mail, Listserv, Bulletin Board, Chatroom, etc); and between instructors and designers. In addition to all the above, the researcher probed the course layout design and use of multimedia technology.

Mathieson's framework for triangulation was used to analyze the phenomena of Web sites, instructional materials, and the insight of professors, distant learners, instructional designers and online course administrators. Data was triangulated where possible, to limit potential bias and data anomalies. The qualitative data collected in this study was analyzed to identify and understand what the strategies are directly affecting the success of a Web course. From the opinions of the faculty members about the instructional emphasis, we educators could reconsider instructional strategies in distance education. From feelings and attitudes of the distance learners, we educational administrators could rethink the effectiveness of assisting adults to learn in the distance. From the preference of delivery technology by distant learners, we instructional designers could develop a better systematic model to accelerate the learning process.

Findings

For the purpose of this research study, the proposition underlying the following section is that consideration must be given to the conditions affecting learning, which are of central importance in Web-based educational environments. Almost all interviewees discussed the process of applying critical thinking skills in teaching, learning and designing Web-based courses. Critical thinking skills provide to online distance students the capability in problem solving; to instructors making the instructional process tailored to distance student needs, and to course designers the selection of interactive instructional technology most appropriate for the learning situation.

The theories and models of how to design instruction discussed in the literature review (Dick and Carey's systematic design of instruction; Gagne's principles of instructional design; Instructional Development Institute (IDI) Model, and Kemp's model of designing effective instruction) are guidance for the researcher to analyze the Web course sites, instructional materials and the experiences expressed by distance course instructors, distance learners, course designers/developers and administrators in distance learning programs. Even though these theories and models are based on the teaching and learning experience from in-classroom instruction, the major components of instructional design of Web-based courses are the same as those in the classroom. No matter where the course is offered, instructors would always reckon the importance of needs analysis, think about the goals and objectives, consider the student characteristics and previous knowledge, plan the procedure and strategies for instruction, design and conduct formative evaluation and summative evaluation as well. What is missed here are the course designers, learning skills, media and technology used to assist the content delivery. As learning is a process of interaction between the student, instructor and resource materials, the student is central to this process. Even though the student and the instructor/professor in an online course were physically separated, there was still interaction between them. The nature and extent of this interaction depends on the technology adopted, the institutional support provided and the type of resources employed. These are the influential points of course design, which the researcher explored in this research study, to investigate if they affected Web-based course design, and to clarify what relationships existed among the components of the online course development.

Distance students who took Web courses usually have their own career and family. It requires self-discipline, strong motivation and painstaking efforts for them to finish an online course and earn college credits. The most important relationship in web-based learning is the communication and interaction between the instructor/professor and a distance student. Without an instructor, the student will have little guidance and direction in learning a specific discipline. From teaching distance students, instructors/professors become more aware of distance student needs so that they can make instructional changes to meet the needs. With the textbook, online study guide and supplementary materials, distance students grasp the principles and knowledge in the course and use them in their work and life if applicable. Students' comments, reflections and projects form the progress of the online course.

Four major findings in web course design from this research study provide a base for the teaching and learning transaction - planning and designing instruction from face-to-face to online. First, the online instruction should be designed specifically for the distance learners. When planning the course, instructors or professors should consider the characteristics of distance students - who they are, what they are good at, how a subject content is delivered to them, and why the course is taught in a certain way. Second, the design must incorporate phases that are both immediate and long-range. While creating and developing a Web course, faculty and course designers should bear in mind the possible outcomes after the course is offered. Meanwhile, they need to take into account that they are creating a course not only for next semester, but next academic year and the years beyond as well. Because the money, manpower and time faculty, course developers, and the institution invest into a Web course should serve the institution for some time in the future. Third, the design of the instruction should be systematic in nature. No matter what interface design is created and what multimedia elements used, the web-based courses should be designed in a consistent manner, representing the culture of an institution though different subject matters require different technological applications. Meanwhile, these web-based courses should also represent the uniqueness of an instructor/professor's instruction. And the fourth, the designing of the instruction, and therefore the inclusion of the instructional strategy and delivery mode, must be based upon the knowledge of how the distance student is going to learn. That means teaching strategies and delivery technology serve the needs of distance students and the purpose of content delivery instead of distance students having to accommodate "the fancy features" just for the sake of using the cutting-edge technology.

Ironically, no matter what format it is in and even though new technologies have empowered faculty and students to learn more, technology increases distance student separation from the instructor/professor and deepens the learning curve of how to utilize it for both distance students and faculty members. On the other hand, technology is the way to bring distance students together - shorten the distance among students, between them and the professor and reduce the isolation they have when learning on their own. In web-based instruction, distance students are empowered by having more control over what they learn, how they learn, and when they learn it. From this research study, distance students found that web technology reduced the role of the professor as mediator between the student and all that is learned. However, neither the Web nor the computer would replace professors. Human beings are still in total control of technology.

Conclusions

The growing diversity of the student population and the rapid development of educational technology have encouraged the popularity of web-based instruction. This research provided evidence of the effective features of online instruction in terms of student perceptions of online learning, the changing role of faculty in teaching Web courses, course designers and developers' cooperation and support from distance learning program administrators. The following paragraphs discuss the conclusions of this research study, which supported the research studies discussed in Chapter Two, and at the same time, contributed to the development of instructional design models and theories in Web-based courses.

Attribute I - The instructional design of a Web course differs from the one delivered face-to-face though in both situations instructors use some technology in teaching. However, the Web-based course requires a team effort from instructors, instructional designers and administrators because with the application of technologies (e.g. computer multimedia for course design, server support for course delivery), Web courses are no longer the creation and development of instructors only as they normally do for in-classroom teaching. This team also has a well-constructed instructional plan that has clearly established course goals, objectives, medial resources, support systems, instructional strategies, choice of technological application, and a plan to evaluate the effectiveness of both instructional and technical delivery strategies. Web courses must be organized around the acquisition of the knowledge, skills, understandings, and values that are applicable to students' real life tasks. In Web course design, using appropriate techniques and technology to serve the learning goals is very important, so careful planning and clear guidance should be provided for distance students to have meaningful, satisfying, and realistic objectives to guide their learning activities. Web course designers or developers should make sure that the learning activities and experiences are supplemented and enriched by the use of related materials, Web resources, and online activities. The Web-based course should allow distance students the choices to decide how they are going to learn, when they will learn it, and how they are to verify that they have met the desired objectives.

Attribute II - The effective instruction with technology depends on several interacting elements: the nature of the content to be learned, the feature of the technology used, the cost of delivery, the quality of the learning experience, the time available, and faculty or program ability to respond to students' needs. According to all the feedback from the distance learners interviewed, online instruction is effective, especially when the distance students are engaged interactively in a process of knowledge inquiry, technology application and self-development in learning. The implication of the interaction from the feedback of instructors interviewed is that online instructors should use certain instructional strategies (group project, team work or individualized assignment) to facilitate interactions among students, thus enhancing collaborative learning. This was accomplished among the three colleges and universities in three ways: (1) by designing interaction between the student and the instructor, such as solving an actual "learning problem," (2) by designing interaction among the distance students and between project teams/groups for collaboration, and (3) by designing interaction between the student and the subject matter with certain software (e.g. Micromedia Authorware) designed for this purpose. The distance students engaged in active, real-life learning experiences, which were relevant to one another, and to the problems of home, school, and community.

Attribute III - The effective use of the Web technology lies not in the form, but in its ability to serve specific instructional goals and desired learning outcomes. We can use a variety of delivery techniques to bring about distance learning. The focus must be on learning and what brings it about, not the mechanism of delivery, or the course production techniques. The technology one chooses to use must be compatible with the instructional methods and strategies employed. The underlying consideration for distance learning should not be compromised by the choice of technology. With more new and user-friendly technologies available and larger distance education programs that support more variety and innovative activities in course planning, this is an explicit direction in Web course design and development. However, effective decision-making raises another difficulty as the number of choices grows (Web programming software, multimedia applications, computer equipment, larger servers, etc). The selection of appropriate combinations of feedback options between online professors and distance students (telephone, email, fax, discussion board - asynchronous communication, and virtual chat -synchronous communication) is also within this category of decision-making.

Attribute IV - The faculty members are critical to the success of an institution and to the enrollment of distance students. The researcher concluded that from students' point of view, a "good" instructor or professor, no matter where they teach and in what mode of delivery, ought to plan for the entire course, organize the teaching methods and materials, and implement effective teaching strategies. Online instructors and professors are certainly required to do more than what is for good classroom teaching. For instance, they need to be a master of using the Web technology in addition to regular course planning and preparation. For Web-based instruction, online faculty members should be aware of and sensitive to the challenges mentioned above; therefore, online instructors should approach Web-based teaching with a predisposition to meeting the challenges with whatever strategies they could find and use.

Attribute V - The most helpful and critical instructional elements for distance students in Web-based learning are (1) timely feedback from an instructor or a professor and (2) the tutorial materials for distance students who have never taken an online course before. From the interviews, the researcher found that online instructors and professors realized the importance of "turn-around time" on discussion and assignments. Before various electronic communication methods were considered and compared, they worked together with instructional designers and course developers, planned their lessons, and implemented feedback into Web courses on the basis of instructional functions to serve the course objective. Then the course designer or developer made use of a certain technology to accelerate the process of timely feedback.

Recommendations

Recommendations for Web Course Design

From the distance learners' perspective, orientation and tutorials (by print or online) should merge for the purpose of preparing distance students to learn online. These tutorial materials should highlight prerequisites of computer hardware and software, survival learning and technical skills, how to navigate the course materials and learn on the Web. Overall, the tutorial should enhance distance students' confidence to complete the course. A careful and thorough course introduction seems to raise non-traditional students' motivation for a successful learning experience.

As for the size of an online class, the ideal one should be similar to that on campus - around 25 to 30 because the faculty members interviewed in this study expressed their difficulties in handling a larger online class. The reason is that if more than 30 distance students engage in online assignments, email correspondence, electronic discussion and virtual chat, the instructor or professor will be overwhelmed by the different demands of the students. The timeliness of online feedback and grading would suffer because all the Web course interactivities mentioned above are time-consuming.

A major question when considering any technology for the delivery of online instruction must be "What type of learning will it assist and how will that shape student learning?" Every technology has its pros and cons. The choice of technology depends on the discipline area, the instructional goals and objectives that distance students are striving to reach, and what purpose that technology serves. Learner feedback must be designed into online courses on the basis of instructional criteria before considering the constraints of a particular delivery technology. This will not only increase the probability of designing feedback of optimal instructional quality, but also avoid the pitfalls associated with concentrating primarily on technological opportunities or limitations.

The maximum interaction among distance students should be fostered by careful consideration in the instructional design, that is, a built-in intention to increase student interaction for an objective of the course. It can also be the case that there is a relationship between types of interaction - learner-content interaction, learner-instructor interaction, and learner-learner interaction. Furthermore, course developers and instructional designers need to pay attention to applying a certain type of interaction to a different course requirement in a certain discipline area. For example, discussion boards can facilitate communication among distance learners; virtual chat can provide distance learners with the opportunity of meeting an expert in the field or the course instructor during the virtual office hour; CD-ROM or Web lab can give distance learners the tool to conduct lab experiments electronically.

Based on the findings and conclusions of this research study, several components in online instruction need special attention. These components are dealing with the underlying issues of distance student characteristics and needs, the influence of multimedia upon the instructional process, and the new roles of professor, Web developer, site facilitator, and non-traditional students in the distance learning process. There should also be continuous and periodic student and program evaluation to assess the progress respectively.

Recommendations for Future Research

The findings of this research study also indicate the need for further research in the areas of motivation and expectancy of distance learners as well as learner-centered instruction. Every distance student interviewed has his/her own reason to take online courses. They were motivated for career promotion, professional improvement and personal growth. They expected someday to function more effectively at work, make more money and feel better about themselves. With all in mind, these distance students (normally with jobs and family) disciplined themselves to find spare time to do the homework and assignments without an instructor pressing on them as in the classroom.

Since this study focused on the attributes of Web course design, the researcher did not spend much time and energy in exploring deeply into the following questions. Are there any other elements related to the motivation and expectancy of distance learners as well as learner-centered instruction mentioned above? What is the nature of these variables? What roles do they play in the successful completion of Web-based courses, and furthermore – an external degree program? More research in the future will add much to our understanding in Web course design and development so that educators can serve distance students better.

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Digitizing a Cultural Heritage - The Key Issue for Preservation and Electronic Publishing

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Abstract: Digitizing is the first and most important step in a preservation and electronic publishing process applied to analog information available today as text, graphics, or multimedia. In most cases, it cannot be done by museums alone.

In this paper we describe our realization approach to evaluate the best fitting service provider in the context of 'The Digital Beethoven House' project. It was a difficult task because the digitizing of a composer-referred collection of colored manuscripts and other sources was a pilot project for all participants.

The paper gives practical hints for museums how to find the right scan service providers, how to do the digitizing of their museum's stock right and how to receive useful output for the museum's Internet offer.

Introduction: 'The Digital Beethoven House' Project

Since 1889, the Beethoven House Association in Bonn maintains as private carrier at Beethoven's birthplace a museum for the life and works of Ludwig van Beethoven (1770-1827). Beside the museum and its collections, a Beethoven Archive as scientific research institute, a publishing house and the chamber music hall H. J. Abs belong to this unique ensemble.

Only a small part of the collection can be shown for preservation reasons or from lack of space in the permanent exhibition or in special exhibitions at the Beethoven House.

The project 'The Digital Beethoven House', in which GMD participates as technology partner, starts here. The major target of the project is it to enable a more intensive occupation with life and works of Ludwig van Beethoven for a broader interested audience [Bogen & Lahme & Lechner 99].

It is an innovative digital library project, in which for the first time worldwide a composer-referred collection is made accessible by multimedia. For the first time music will be visualized in a virtual installation, for the first time music handwriting and other composer-referred documents will be digitized in colors. Naturally, 'The Digital Beethoven House' will be Online in the Internet.

This paper is structured as follows: The next section introduces our methodology to find the right scan service provider for 'The Digital Beethoven House' project. It is followed by a chapter that describes our respective requirements in more detail. The further section is about managing digital documents for publication purposes. The paper is complemented by some remarks on digitizing audio, video, and 3D models. Finally, the last section concludes the paper with some general remarks on the results so far and those expected to be achieved until the WebNet'2000 conference.

Realization Approach

The largest cultural treasures are situated behind fireproof walls and steel doors, protected against light and humidity, air-conditioned and dust free. The Beethoven House Association in Bonn e.g., store over thousand inestimably valuable manuscripts of the composer Ludwig van Beethoven: music handwritings [Fig. 1], letters [Fig. 2], sketches of sheets of music, first prints, colored engravings [Fig. 3], photographs, pictures. 9,000 colored pages of them and more than 16,000 pages in gray tones, with formats that go from DIN A6 to DIN A2, in parts even bound, are going to be digitized. But several questions arise:

- How does a museum achieve a future-proof digital archive, respectively digital copies with highest image quality and similarity to the original, which are applicable to various future purposes?

- Is the own personnel qualified to execute the scanning work, in order to be prepared for later extensions?
- Or which image service bureau will meet the requirements for professional scans in color?

In the case of the 'The Digital Beethoven House' it was decided to charge a professional image service provider: Reproduction specialists, who are characterized by their daily work with high-quality colored historical collections. GMD as technology partner and consultant in 'The Digital Beethoven House' project was charged to find a competent scan service. The following methodology proved successful in doing so.

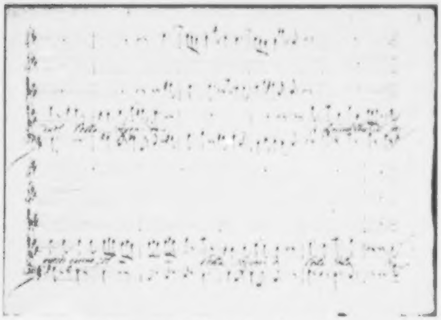

Figure 1: Music handwriting

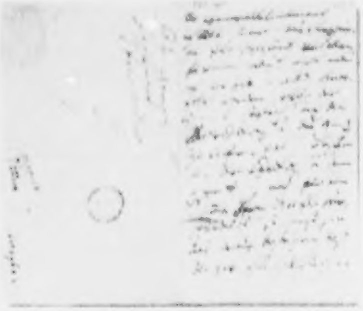

Figure 2: A letter of Beethoven

Step 1: Development of Quality Criteria for the Whole Digitization Chain

A qualified scanning process needs to meet the requirements of the special documents of the museum. The criteria for the whole process of electronic publishing were collected.

Step 2: Market Analysis of Scanning Services and Call for Tender

The market was searched for potential candidates who were invited to offer their services according to the quality criteria of step 1.

Step 3: Evaluation of the offers

Each offer was looked through carefully. The most promising companies were chosen for a detailed view.

Step 4: Visits of the Best Qualified Vendors

The best scanning vendors had the chance to present their color consistent scanning chain and their professionals while scanning special exemplary originals of the museum. Digital copies on CD-ROM and proof prints were taken with us to compare the results of the different service providers.

Step 5: Decision Making

For each vendor we evaluated the fulfillment of our criteria.

The results were sobering: 6 out of 15 scanning services responded to our call for tender, out of which we chose 3 for a detailed evaluation. There were no scanning services with long-term experiences in scanning colored composer-referred collections! They had a lot of experiences with two-tone or grayscale documents but for colored manuscripts they were all still learning. None could present color fidelity for all components of the digitization chain.

We decided for a candidate with experience in the whole digital library environment who presented a comparison of 8 different scanner types in contrast, color, sharpness, and depth of focus, tested with a representative test chart of the "Landesarchiv Baden-Württemberg" (Fig. 5).

Quality Criteria for Digitizing Paper

The requirements for the digitization process orient themselves at the nature, the condition and the value of the source material. The prime motto is to scan only once and to touch the original never again. As output of the scanning process the digital images must be of preservation quality, in order to use them instead of the historic collections themselves.

In the following paragraphs the most substantial quality criteria our outlined. They lean against national and international scanning guidelines experiences [Kenney & Chapman 96], [Mittler 98], which we evaluate in the light of our practical experiences.

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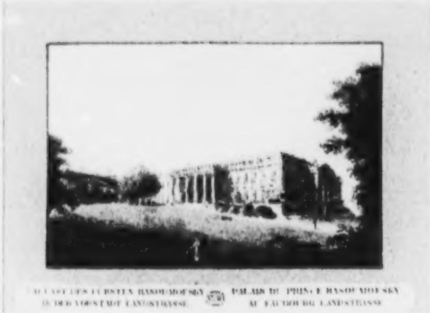

Figure 3: Colored engraving

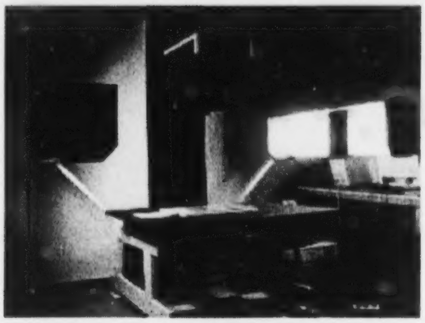

Figure 4: Highly qualified scan equipment

1. *Quality of Scans: Which image quality requirements are essential to achieve best quality copies?*

   Knowing that high quality extends the life of a digital collection, we decided for scans with at least 400-600 dpi and 48 bits color depth for colored material as well as for grayscale documents. We learnt that these are only corner points for the image quality, which cannot be forecasted with one or two features. *First, we know how many things can go wrong from the source material to the copy. Second, we know that in all cases we must give up something from the original [Chapman 99].* In the long run the practical demonstration and the digital outcome of a calibrated [ICC 93] digitization chain with sample charts must convince the musicologist of the similarity to the original. Likewise a compromise between image quality, filesize, and costs must be met.

2. *Digital Master: How largely, respectively how 'rich' is the digital master to become?*

   The digital master will not be transformed after scanning and captures all the information. As output format for this rich master we decided for the TIFF [TIFF 92] standard, which can be read from, written to and converted to by the common systems. The technical meta data will be stored within the header, in order to hold preservation information as close at the picture as possible, bibliographical and structural meta data will be stored as XML-files. As medium for the digital master and its ICC profiles [ICC 93] we chose CD-ROMs using an ISO standard [ISO9660 88] for storage which is not yet the case for DVDs. A storage concept will migrate these storage media to long-term solutions.

   Because of the administration overhead and the loss of quality for later digitizing, microfilms were no options for our work.

3. *Scan Equipment: Which scanner supplies the desired quality for all sizes and document types?*

   Several types of scanners are available for digitizing documents [Kenney & Chapman 96]. The appropriateness for a museum depends on the category of the archival material. *Physical handling is one of the most destructive things that can happen to a fragile object. One of the best ways to preserve it is to limit physical access to it [Noerr 98].* The originals have not to be damaged by contact, light or heat and must therefore be digitized as contact-free as possible. After the demonstration of different scan equipments and their results, digital cameras [Fig. 4] with book seesaws appeared to us best suiting for museums. They meet best the quality requirements for all document sizes and scan contact-free and face-up. The scanning speed is an essential and very cost consuming feature. Complete scans (incl. preparation) should not take more than 3-5 minutes.

4. *Experiences of a Scanning Service Provider: Which image service bureau is trustworthy?*

   The scan service is supposed to have reference projects where it handled similar archival documents which often are faded, torn, written on special paper and with ink, and even stitched. Reference projects should be verified by the customer. Experiences with grayscale or two-tone documents are not sufficient. The use of modern equipment by professionals taking into account the exclusiveness of the documents is decisive.

   Each step of the digitizing needs to be coordinated and documented by the scanning service provider to use the expensive equipment to capacity and to clearly define the interfaces to the customer.

Managing Digital Documents

The digital results must be of *functional* quality, so that the production of many types of derivatives is possible. The motto is to scan once and publish often. We present the most common publishing scenarios.

Digital Library and Internet publishing

After digitizing a museum is able to offer its treasures to the public via a Web based digital archive. Different access concepts will be realized, is it the minimal request for thumbnail images on screen or is it to offer full screen pictures for scientific workstations. In our application context three groups of users are going to be addressed. The Internet users have reading rights to the digital images with a lower resolution, but to the complete meta data. The Intranet users of the museum or the library have access to the material with higher quality as well as the visitors, travelling to Bonn and accessing the data via the public workstations in the Beethoven Salon, a real place on the premises of the Beethoven museum.

The digital master is the starting point for the subsequent treatment in order to serve the specific purposes. Its quality features described in the previous chapter make sure that each considerable size or format for current and future applications might be produced afterwards. The public never gets to face the large digital masters in the original format but rather its derivatives. On the basis of the ICC [ICC 93] profile the original RGB scan [Marshall], the *archival digital master*, is transformed to an image of the LAB color space [Marshall] with 24 bits color depth, the *processed digital master*. The processed digital master is converted to handy image formats, e.g. jpeg or forms of the wavelet [WAVE] compression which are more appropriate for the performant data transmission in Internet networks. It provides progressive loading, scalable sizes and quality that may be accessed with password protection. Other formats like flashpix [Rigby 96] are in discussion to meet the requirements of zooming of different image pieces.

The digital archive is part of our integrated digital library solution where the digital copies are brought together with already existing data providing captured information e.g. from the proprietary library systems.

CD-ROM Production

Digital copies of high quality (e.g. TIFF-format [TIFF 92]) will be used for Offline media like CD-ROMs which people may order to buy copies of their favorite documents. We chose the ISO 9660 [ISO9660 88] standard because of platform independence.

Facsimiles and Posters

The quality criteria for scanning are appropriate for the creation of high-qualified facsimiles reprints, the output of the digital master to the same analog medium as the original. Whether digital printing techniques with ICC profiles [ICC 93] are used or whether offset printing techniques are brought into action with manually adapted characteristic printing lines musicologists should check the color fidelity and the whole appearance of the facsimiles on the used paper.

Enlargements for posters may be easily printed because a low resolution is sufficient for a distant view.

Virtual Reality

Some of the scanned material will be used to build 3D models for a virtual world, like Beethoven's last study which visitors may experience in the context of the 'The Digital Beethoven House' [Bogen & Borowski 98]. For this virtual reality work scanned material with a resolution of 100 dpi is sufficient.

A Short Glimpse at Digitizing other Media

Collections of museums today contain more than just plain text documents and pictures. Multimedia material like audio, video or 3D objects have to be digitized and integrated too.

Audio: Most audio data are already digitally available on CDs. But these audio CDs cannot be used directly. They have to be converted to another digital format. For doing this a normal CD device in a computer together with special programs to read the audio tracks are enough.

However, proprietary audio data on analog media must be digitized differently. In spite of existing special hardware for this task, in most of the cases (e.g. small music pieces) a PC with a good soundcard and special programs are enough.

In 'The Digital Beethoven House' project only a few audio data from chamber music hall recordings have to be digitized. So a simple PC will be used for this purpose. The result is always a WAV file [RIFF]. This is the standard PC format but not a good solution for the WWW. Before converting the WAV files, it must be decided, whether streaming audio or download on the WWW should be provided. For streaming audio it is still the RealAudio format [REAL] to prefer. As a download format today MP3 [MP3 93] becomes more and more the standard.

Video: To digitize video data, there are many possibilities. It mainly depends on the source of the video data, how to digitize it, and on the future use of the digitized video.

In general, a video capture card is needed to digitize the analog format. As a standard output one or more Audio Video Interleaved (AVI [RIFF]) files are generated. The problem, which may occur, is that AVI files have a maximum size of 2 GB.

In a next step, the video can be edited, if needed. At the end, the AVI format has to be converted to other video formats. Which format is preferred, depends on the further use of the video. The most used formats are QuickTime [QUIC], MPEG [MPEG] and RealVideo [REAL]. All these formats have a loss of quality but a handy file size. The frame rate for the video compression can be selected. The standard for PAL is 25 frames per second (fps). This is mostly too much for the WWW.

To present the (streaming) video in the Web, a streaming server is needed. This solution is preferable to downloading the video.

3D Objects: Virtual 3D models of artwork, industrial products or any other physical object can be produced today with commercial equipment for 3D scanning with high accuracy. The objects are scanned by non-contact digitization methods; only light touches the objects. As an example the digitization of works of arts in a museum will be discussed here. The advantage for a museum, which possesses also digital models of its stock, is on the one hand the local and WWW based accessibility by art historians, educators and the public without strain for the artwork. On the other hand it is an important advantage to improve the accessibility by turning the viewing of art into an active rather than a passive experience. In addition to education, science and entertainment, the produced virtual models can be used for commercial and marketing purposes which is especially interesting for digital museums accessible through the WWW.

Figure 5: Test chart (Landesarchiv Baden-Württemberg)

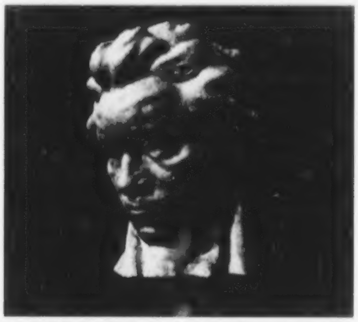
Figure 6: 3D scanning of a Beethoven marble bust

The principle steps for the production of a virtual model and for making it accessible are 3D scanning, modeling with help of the resulting range image data, and visualization of the final virtual model. A laser triangulation scanner and a motorized gantry are used to produce a 3D polygonal surface mesh for objects of small dimensions as well as for very large objects like, for instance, the giant figure of Michelangelo's David [Levoy 99]. After generating range images for all parts of an object's surface, these range images are combined into a single polygonal mesh with the help of surface reference points. The resulting 3D mesh completely describes an object to the extent that it is visible from the outside. Along with the range images photos of the surface are taken and mapped onto the combined mesh. To prepare the virtual model for interactive visualization light sources, material descriptions and a view point are now added to the mesh (see Fig. 6).

To finally view the virtual model and to allow interaction a software tool for 3D rendering and interactive visualization is needed. Possibilities for manipulation of virtual models by museum visitors can be to interactively change the view point in order to see an artwork from unusual directions, to change the lighting or to compare it directly with other objects created by the same artist or in the same period of time. To make the 3D model accessible for Web users a conversion to the VRML format [VRML 97] is recommended. Users connecting to the museum's Web server can download the model and visualize it directly in their Web browser using a VRML plug-in.

Conclusion

Considering the whole digitization chain, scanning is the most important period. The error rate needs to be as small as possible to treat the original documents with the highest amount of care. We presented our methodology and quality criteria that proved successful to find a qualified scanning service for digitizing paper. We outlined especially those criteria, which we find helpful for other museums and libraries before starting their work. Although the investment in the highest image quality is necessary to build a future-proof digital collection, all the decisions described have to balance quality and cost.

The digitizing of Beethoven's heritage following the concepts described so far were planned to take place from the 1st of March 2000. During the starting phase however some problems caused a delay of several month. One of the major challenges for the digitizing service was to guarantee color fidelity in the whole digitization chain without loss of quality. Staff changes on the side of the scan service were necessary in order to engage a company that really was able to install ICC profiles [ICC 93] for each component of the digitization chain. In July 2000 new tests for different document types (images, prints, handwritings, letters) will proof true the color profiles, so that the production can be started as soon as possible. During the conference in October/November 2000, we will be able to present our approaches to the process.

However, the final proof of concepts will be achieved only while implementing and offering the full version of the 'Digital Beethoven House'.

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Enhancing Interactivity for Self-Evaluation in XML-Based Courseware

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Abstract: The paper describes an educational application, oriented to university students, to help them to learn the SQL language in the ambit of a course on database systems and applications. This tool is integrated with a XML-based framework for courseware authoring, whose main characteristic is flexibility, since contents are presented to the students in different ways, depending on their previous knowledge, on the kind of hardware used to access the content, and on some preferences of the user. The implemented application is interactive, and allows the students to practice their understanding and their skills about the SQL language, following the approach of "leaning by doing".

Introduction

Internet can represent a very effective platform for learning, providing many of the tools needed in the educational process, from the definition of curricula to the collection of educational material, from the delivery of this material to the interaction between the involved actors (Boyle, 1997, Farinetti et al., 1997). A large number of educational institutions are now involved in developing on-line courses used for distance learning or for supporting traditional face-to-face learning, usually providing a high level of interaction between users and authors.

The design of on-line courses involves different actors, that have different requirements: the *teacher-author* needs a tool easy to use in order to create the educational material; *the student-user* needs something more than a mere translation of a book in electronic format, that is some sort of guidance, a high level of interactivity and a tool for assessing the learning process; the *site administrator*, finally, needs an easy-to-maintain system for updating the content and the information about users.

Implementation of effective educational platforms needs to carefully take into account all of the previous requirements. For this reason we designed and implemented an application framework able to allow teachers with no specific computer science skills to create courses composed of different content formats: simple text and pictures, but also audio/video streams, Java applets and animations. The main characteristic of the tool is flexibility, in the sense that contents are presented to the students in different ways, depending on their previous knowledge, on the kind of hardware used to access the content, and on some preferences of the user (due to special educational needs, for example). In order to acquire new knowledge, students are supposed to study, to practice new concepts, to solve problems and, very importantly, to assess their knowledge level thank to self-evaluation mechanisms. Besides that, the system is designed to be simple enough for the site administrator, since it maintains all the course information in one file only, and most of the processing is done on the student's computer; in this way one small server can provide content relative to a large number of courses to hundreds of students.

The developed application uses *XML (Extensible Markup Language)* for the organization of the contents, assuring a simple way to modify the presentation of the modules. The contents can be created either by using a simple text editor, or by using an XML editor, or by using a dedicated content-creation application at present under development. The use of the XML standard, which uses text files to maintain database-alike content, was the key for obtaining the desired flexibility.

One of the main advantages of hypermedia with respect to traditional educational aids is the possibility of interactive learning, self-assessment and self-evaluation. The developed application allows the insertion of animations, simulations, quizzes, video and audio streams and other form of interaction. The present paper is focused on interactivity, and aims at describing advanced possibilities for self-evaluation.

The paper describes a case-study for the XML-based framework, consisting in the design and implementation of courseware on database systems and applications. In courses about databases, usually the part regarding SQL language is the most critical: SQL can be difficult to learn, it is quite hard to get access to SQL servers, most of the tools are specifically made for designing application, and quizzes on SQL cannot be used to obtain an accurate information about the level of acquired knowledge. The proposed solution consists in the implementation of an on-line module for SQL training and self-evaluation.

The application framework

The XML framework aims at providing an educational-oriented authoring tool, capable of producing on-line courses with a structure and organisation of the contents already defined according to an educational methodology. The on-line courses developed with that application are flexible enough to adapt to different user profiles, with different entry levels in terms of already acquired concepts and skills, different learning goals, different hardware resources. For this purpose each course was considered as a collection of modules, part of a homogenous structure; each module has clearly stated pre-requisites for the fruition and well defined learning objectives. Entrance and exit levels of knowledge associated to each module permit the dynamical building of the educational path according to the student profile. Furthermore, each module allows different views of the content, since it consists mainly of a collection of sub-modules offering different presentation formats:

- the *introduction* sub-module, where the main goal of the module is stated, together with the list of the contents and the pre-requisites;
- the *main content* sub-module, which is the real body of the course, containing the explanation of all the concepts and procedures;
- the *conclusion* sub-module, which consists in the summary of the module, i. e. a list of the fundamental concepts the student should have acquired after studying the main content;
- the *example* sub-module, which is a collection of examples that help the student understand the concepts better;
- the *exercise* sub-module, which contains a collection of exercises with their solutions so that the student can check the knowledge of the concepts presented;
- the *test* sub-module, which provides self-evaluation under the form of a test with automatic feed-back; it consists in a set of questions with predefined answers, and the result obtained by the students influences the presentation of the subsequent modules.

The self-evaluation mechanism allows the student to test his or her level of knowledge and understanding of the concepts, permitting as well the dynamical building of the educational paths among the modules of the courses. Two types of tests are proposed: a preliminary test, used for determining the student's level of knowledge when he is making the first contact with the course, and a final test for each module, used to determine whether or not the student has acquired the required exit level of knowledge for the module, and to choose the level of presentation of the following module. According to the results of the final test, the profile of the student is modified, and the choice of the following module is based on this profile. The main idea is that the better the student performs, the less content she needs. In an extreme situation, the student that did not acquire the desired level of knowledge could be forced to study once more the same module, in order to acquire the minimum level of knowledge required to proceed to the following module. A course structure like this has two degrees of flexibility in building the educational paths: on one hand it allows the combination of different modules, and on the other the amount and the type of information presented in each module vary.

The application uses XML for the organization of the contents, yelding a simple way to modify the presentation of the modules. At this purposes, we defined a grammar for all the courses, which is contained in a DTD (*Document Type Definition*) file (Megginson, 1998). The grammar lists the rules the course should satisfy, that is the division in different modules and the different views of each module (the sub-modules described above), together with information about the course and the course authors. For each sub-module we defined the possible contents and the minimum information that should be present.

As an example, each test contains a list of questions and their possible answers, a code for the identification of the test (either preliminary or final), the name of the test, and the location of the CGI program that evaluates the answers (that is part of the application as well). Most of the other sub-modules contain a title and some paragraphs. A paragraph can contain text, other media – images, audio, video, animations – or some sort of interactive unit. Some sub-modules are not mandatory (*example* and *exercise)*, their presence depending on the way the authors structure the module.

The appearance of XML document on the users' screen depends on the associated XSL (Extensible Stylesheet Language) document, that controls the fonts, the colors, the size, and the amount of content to be displayed. The XSL files need to be different according to the profile of the user, and are based on a general XSL template and on some specific hardware configurations. The hardware characteristics of the user's computer, the speed of the connection, the previous preferences of the user influence the display of the multimedia content. For example, if the student uses a low-speed connection no audio/video stream is presented; on the contrary, in case of high-speed connection most of the multimedia content are displayed. For a person suffering of hearing impairment no audio content is presented.

In order to have this degree of flexibility for the display of the contents, the implementation uses two CGI programs, one to create the XSL file on-the-fly, and the other to generate the XML processing instruction required for processing the XML file and for displaying it on the screen. The XSL file is specifically generated for each user, depending on his or her profile (Farinetti et al., 2000).

Most of the courses provide interactive features for self-evaluation, through the use of tests with multiple answer questions. Some course may need a higher level of interactivity, so that the student can practice and test his or her knowledge in a more sophisticated way with respect to the one provided by the tests. Even if the *exercise* sub-module shows some problems with the possible solutions, in some cases these are not enough.

A course for learning database systems and applications, that uses this XML framework, is now under implementation and testing, and we observed that the students need some advanced form of interaction that allows a "learn by practice" approach. We decided to implement an interactive feature able to allow the students to practice and test SQL queries using a specific database – the one used in all the examples of the course (Date, 1990). In this way the students can learn directly from their own experiments, trying different queries and seeing the result immediately, or looking at the possible errors their query contains. The advantages of such an approach are obvious: the interaction offered by the application represents an increase in the quality of the educational process, allowing a fast and accurate method for the students to test their knowledge. The SQL application presented in the paper will be integrated in the *exercises* sub-module of the on-line course on databases, and we are evaluating the possibility of integrating it in the *test* sub-module too.

Interactive tests

The application has been specifically designed to help students to practice SQL language, a task not easy to do using common tools. Usually it is quite difficult for the students to practice SQL, since an SQL server is not easy to configure without already having quite a good knowledge of the SQL language, and access to an existing one might be hard as well. There are only a few client tools that could be used to practice SQL by those having low-level knowledge of the language, and the interface provided by most applications used for database courses does not allow the student to use SQL in an efficient way. Most of them are not intended for learning purposes, but for the design of applications, and they allow the use of a limited subset of the SQL syntax. An application for educational purposes should allow the students to check their knowledge of SQL, with an automatic feedback, but going further than proposing a test with questions and predefined answers. An open questions test is the best tool for self-evaluation, and the application should propose different problems to the student, get the answer and evaluate it correctly.

The interactive SQL *exercise* sub-module provides three important functions. The first one consists in offering the user the possibility to practice any SQL query and to see the results almost instantly on the screen. The second functionality is proposing problems to the students and allowing them either to test a solution, or to request an evaluation of the solution. The third functionality is a variation of the second one and will probably be integrated in the *test* sub-module, using different levels of difficulty for the problems, based on the level of knowledge of the student (obtained thanks to the XML framework).

The first one is important from the student's point of view, which is interested in practicing the concepts and the skills that he is supposed to acquire during the course, by experiencing directly how small variations in a query could lead to different results. The second one provides the student an accurate self-evaluation of the acquired knowledge, by solving real problems, and not just by checking some predefined answers.

The third one is important from the teacher's point of view, which is interested in evaluating the level of knowledge acquired by the students. Based on this the teacher can choose to modify the course, to offer more examples or more exercises, and so on. In addition to this, the XML framework can choose the best educational path for the student using this third functionality.

The first thing that the student has to do is to choose a problem. This leads to a screen that contains the statement of a problem, and allows the student either to practice SQL queries, or to propose a solution for the problem. The student writes the query and press a button to send all the data to the server specifying whether he is just testing the query or he is submitting it for evaluation. For the first functionality, the student gets a screen with the results of the query, while for the second one the display contains the evaluation of the proposed solution as well. In both cases, if the query contains an error, the student gets the description and the position of the error in the query.

The implementation

In the application we used an Apache web server running on a UNIX machine to provide a simple interface for the students. The students have to choose the functionality they prefer, and fill in the query. For both functionalities the same CGI program will present them a page containing the results of their actions; in the first case the CGI program performs only this task, while in the second case it also checks whether the query inserted by the student is a possible solution for the proposed problem. The CGI programs interacts with a SQL server; the structure of the application is shown in Figure 1.

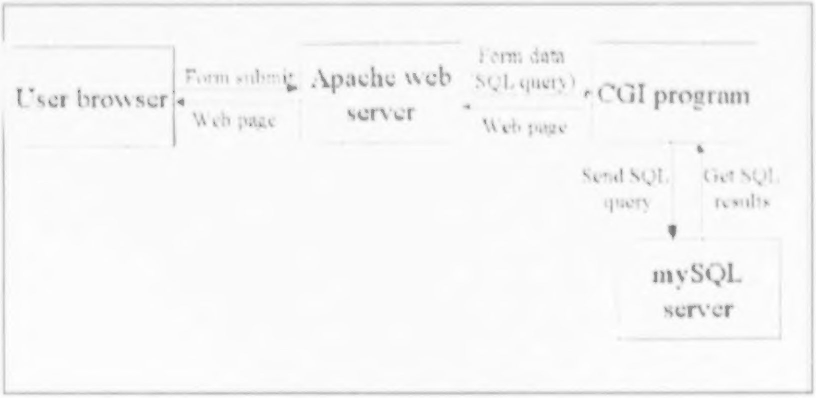

Fig. 1 – Structure of the application

The application has to distinguish between the read-only queries and the ones that perform write or update operations. The simpler read-only queries (SELECT, SHOW, DESCRIBE, EXPLAIN) are dealt with directly, running the query on a mySQL server located on the same UNIX machine as the web server, while for the queries that require modifications of the database (UPDATE, INSERT, DELETE), a new temporary database is created, by copying the original one, and all the changes are made only in the temporary database. In this way, each time someone is using the application, he can be sure that data are those presented in the examples of the course, no matter how many other students used the application before. After displaying the results, the temporary database is removed from the server, so that the application is stateless. At present students are practicing using a single-query model, and all the proposed problems are supposed to be solved by using a unique query. It would be quite easy to pass from a stateless application to a stateful one, by implementing some kind of user identification, so that the

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temporary database is maintained waiting for another query from the same user, and it is removed only after a timeout period, but at present this was not one of the goal of the application.

Both functionalities are based on the use of the mySQL C API. For the first functionality, the query is executed by the CGI program and the results are formatted in HTML code and sent to the student's browser.

To verify of the correctness of the solutions proposed by the student, the comparison of the queries was not a good solution, since the correct result can be obtained by many different queries. To evaluate the results, one of the correct queries is stored in the sub-module: the application runs it on the SQL server, and its result is compared with the one obtained by executing the query proposed by the student. In the case of a read-only query this is very simple (even if different approaches are needed, one for the case that the problem does not require ordered results and another one when the problem requires ordered results), while it is a little bit more complex for the queries that modify the database (in which the contents of two different databases are compared).

Another problem to consider is the possibility that for a specific database some incorrect queries could return correct results. This happens usually in databases where an injective functions exists between some subsets of the values of two fields, so that selecting the records with a given value in one of those fields is the same as selecting the records with a specific value in the other field. As an example, in a fruit database, that contains the name of the fruit and its color, in the case that the only red fruits are apples and all the apples are red, selecting all the apples is the same as selecting the red fruits. If a new record is added to the table, for example cherry which is red as well, this problem no longer exists. In the first case it is theoretically impossible to check the correctness of the solution proposed by the student (since incorrect queries could lead to correct results), so the solution consisted in choosing a database where this problem does not exists (we added new records to solve the problem and disambiguate the records). We used a database very familiar to students, since it is used in all the SQL courses (Date, 1990). We selected carefully the values to be used in the database so that the problem above mentioned does not occur for any of the possible queries.

In the case the query proposed by the student contains a syntax error, the CGI program shows the error and gives some form of advice about the source of the error and the actions the student could take to correct it. In this way the student can see immediately the mistakes, can go back and correct them, learning from them.

The problem of the security of the database has been considered as well: in case of read-only queries the connection to the mySQL server uses a username and a password that allows only read-only access to the course database, while for the modifying queries a different username and password allows read-only access to the course database and the right to create a new database (so that the creation of a new temporary database is possible, with full rights on it).

The modular implementation allows the creation of new functionalities for the students when the need for those arises. In fact, it is possible to implement easily new categories of queries besides the ones already provided: database and table creation and administration (CREATE, DROP), or SQL server administration. This however increases the security problems, and new solutions for the problems created by those types of queries should be found before implementing them in practice.

Conclusions

The designed application aims at providing the students a better way to learn the SQL language; it will be completely integrated in the on-line course on database systems and applications, implemented using the XML framework. The advantage of the designed framework consists in the flexibility of the produced course, which on one hand allows the combination of different modules, and on the other varies the amount and the type of information presented in each module.

Interaction is one of the main requirements of an on-line course, both for providing the students a self-evaluation mechanism, and for helping the author to maintain and update an effective application for learning, by collecting and analyzing the results of the students. The paper described an interaction mechanism that allows the students to practice their understanding and their skills about the SQL language, following the approach of "leaning by doing", and that goes beyond the usual multiple answer tests.

The student can insert and evaluate queries for solving the proposed problems, and have an automatic feedback on possible mistakes or misunderstandings. He or she can also use this facility only to experiment the results of queries, to practice what they learned. The proposed interface is much easier than the tools usually available to students, that have not been designed for educational purposes.

In the future we intend to develop a stateful version of the application, allowing the students to perform multiple queries in sequence and to see the results immediately after each one. This would permit the teacher to propose more complex problems for the students to solve, and would allow the students to experience more realistic situations.

where they will have to create a database, populate it, modify and update it, obtain data from it and so on, operations which of course cannot not be done using just a single SQL query.

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Using Multi-user Distributed Virtual Environments in Education

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Abstract: On-line learning is one of the emerging needs of the information age. Access to education is going to become crucial for the success of our information society. Therefore a lot of potential is seen in distance learning and distributed virtual environments. The communicative character of the distributed virtual environments would allow for students and stuff to meet in social shared spaces and engage in on-line real-time seminars and tutorials. Such technologies may mitigate some of the problems of isolation that distance learning brings. This paper presents multi-user distributed virtual environments, which are designed and implemented for educational uses.

Introduction

Multi-user Distributed Virtual Environments (mDVEs) allow a group of geographically separated users to interact in real time (see Bouras Ch., & Philopoulos, A. 1998). While a simple Virtual Environment (VE) is a computer-generated simulation, which aims to provide its users with a sense of realism, an mDVE is something more. First of all in an mDVE, multiple users can interact with each other in real time, and furthermore the VE is distributed, running on several computers, which are connected by a network, using a series of client server applications (see Bouras Ch., & Philopoulos, A. 1998, and Waters, R.C. & Barrus, J.W. 1997).

There are many research projects and systems in the area of mDVEs such as DIVE and SPLINE.

The Distributed Interactive Virtual Environment (DIVE) (see Frécon, E. & Stenius, M. 1998, and DIVE) is an internet-based multi-user VR system where participants navigate in 3D space and see, meet and interact with other users and applications. DIVE supports the development of virtual environments, user interfaces and applications based on shared 3D synthetic environments. DIVE is especially tuned to multi-user applications, where several networked participants interact over a network.

Scalable Platform for Large Interactive Networked Environments SPLINE (see SPLINE) was designed and implemented by MERL researchers and provides capabilities such as multiple users, spoken interaction, computer simulations, human computer interaction, 3D graphics and sound, run-time modifiability and open Interfaces.

Furthermore there are many projects that try to introduce VR technology in education such as VIRLAN, BREVIE and VRLEARNERS.

Foreign Language Virtual Environment for Primary School Children (VIRLAN) project (see VIRLAN) aims to develop a virtual reality language learning network for primary school children throughout Europe. The main results of this project are the use of latest advances of virtual reality and multi-user environments by children in order to be able to "meet" and "communicate" in the virtual worlds, and consequently learn each other's language out of this interaction.

Virtual Reality Learning Environment for Network of Advanced Educational Multimedia Resource Centres, Museums and Schools (VRLEARNERS) project (see VRLEARNERS) has as major goal to facilitate mutimedia access to Europe's cultural heritage. One of the main results of the VRLEARNERS project is the development of a collaborative virtual learning environment providing access to digital archives of European museums.

Bridging Reality and Virtuality with a Graspable User Interface (BREVIE) project (see BREVIE). The main objectives of the BREVIE project are to demonstrate the feasibility and the advantages of a new kind of learning environment for vocational training in production engineering and to establish a baseline for network supported co-operation between media developers, research institutions and media users (teachers and learners).

mDVEs have many characteristics that can be exploited in the educational procedure and especially in the distance learning. More specifically mDVEs offer a way of communication and they give a shared sense of space, presence and time (see Singhal S., Zyda M. 1999). Furthermore an mDVEs application can meet the requirements for a complete Computer Mediated Communication (CMC) system (see Candace, Chou C. 1999), such as ease to use interface, cross platform, conversation logs, indication of the presence of the attendees and multi-modal interaction.

According to an extended review on the educational uses of Virtual Reality (VR) technology (see Youngblut, Ch. 1998) most of the educational VR applications don't support multiple users and they don't provide any type of interaction between their users. More specifically almost two percent of the current applications support multiple users with very limited types of interaction between users. Furthermore, the majority of the existing applications are immersive using head mounted display (HMD) or cave display to visually immerse a user in the virtual world.

Generally speaking, immersive applications are more effective in the use of VR technology. However the main feature of educational VR applications is the interactivity and not the immersion.

Moreover, a VR application, which is designed for educational use should be suitable for widespread use and mature in the part of the technology. Considering these requirements, immersive VR technology is not mature and it is expensive. On the other hand desktop VR is more suitable for widespread use regarding the hardware and software requirements.

In this paper is described a 3D community which is implemented in the bounds of Virtual European School (VES) project (see Bouras, Ch., et al. 1999, and VES). VES 3D community consists of mDVEs. These environments have as primary goal to provide educational material and communication facilities to students and teachers through a user-friendly 3D interface.

The described 3D community in this paper satisfies the above requirements. First of all offers multi-user interaction through chat communication and avatar representation.

In addition, the described environment is an mDVE and it has not excessive requirements from the user-side. More specifically the educational material and the virtual worlds are stored in a server and the user can reach the 3D-community trough a web browser with the use of appropriate plug-ins.

The remainder of this paper is structured as follows. In the next section we describe the VES project and the VES 3D community. We then present the functionality of 3D community. Following this, we describe some implementation issues and finally we present some concluding remarks.

VES description

VES is a European project - funded by the Educational Multimedia Task Force Initiative of the European Union - with the aim to develop a comprehensive on-line resource of teaching material for secondary school education.

The VES system architecture is based on a network of distributed multimedia databases, which acts as the data servers within the VES. One server per participating country (Austria, Italy, Greece, and Great Britain) has been installed. These servers can be accessed via a standard web browser. VES has three target groups: publishers, teachers and students/pupils. For each user group a special Web-based Graphical User Interface was designed. Publishers are provided with a supporting interface for uploading and monitoring the use of teaching material, teachers have search and compose facilities assisted by intelligent wizards while pupils access through a specifically designed interface to work with selected learning material as well as mDVEs.

In general VES system has two main technical results:

1. The implementation of a distributed multimedia database for storing the multimedia-value added teaching material and additional CBT products.
2. The development of a 3D mDVE providing pupils with a powerful tool for learning and exchanging knowledge.

This 3D mDVE is presented in this paper. Currently, the VES system and the corresponding mDVE can only be used by registered users. We have also established an alternative 3D community (see VES 3D) for testing and evaluating purposes.

VES 3D community

The 3D Community consists of 9 virtual worlds (.svr files) (see VES). The first world acts as the entry room to the whole environment and provides general information about the VES project and the three VES access points (Austria, Italy, and Greece). The second world is the hall room from where the user can reach 7 other rooms that act as workplaces to be used by teachers and students for interactive communications through 3D avatars and text chat. There are 3 rooms dedicated for national discussions (Austrian, Italian, and Greek) and four rooms dedicated for thematic subjects (Geography room, Economics room, Physics room and History room).
In (Fig. 1) the ground plan of VES 3D community is depicted.

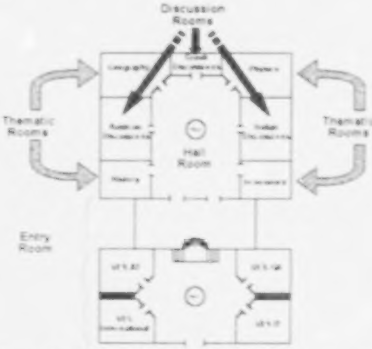
Discussion Rooms
Thematic Rooms
Thematic Rooms
Hall Room
Entry Room

Figure 1: Ground plan of VES 3D community

Functionality

In order to achieve a friendly and appealing user interface, the interaction of the user with the virtual world should resemble real situations. In every virtual world, are defined certain functions and these functions are activated by certain events. These events are related with objects (active objects) and how the user interacts with them. The triggering mechanism of these events can have the following alternatives:

- When the user's avatar enters in pre-defined areas within each virtual room.
- When the user's avatar hits certain objects (collision).
- When the user clicks with the mouse over a certain object (touch).

By using one of this ways, we can have an interactive environment where the user is able to navigate and perform certain activities. An example of the thematic room functionality is shown at (Fig. 2).

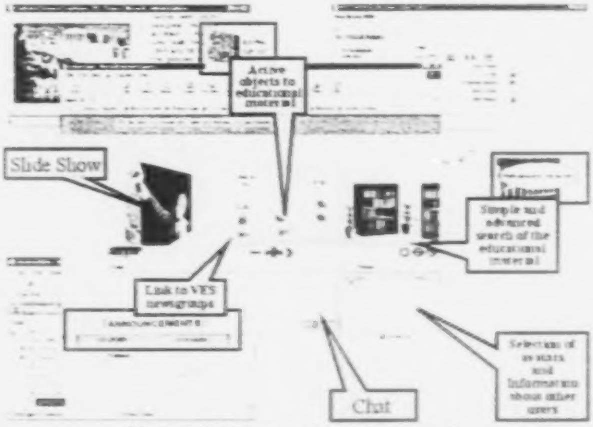
Active objects to educational material
Slide Show
Simple and advanced search of the educational material
Link to VES newsgroups
Selection of avatars and Information about other users
Chat

Figure 2: Thematic room functionality

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In the following sections we describe functions that were designed in the virtual worlds.

Information providing

The main concept here is that a virtual environment should provide information, which is more appropriate for 3D realization. Alternative ways of presenting information within the virtual environment has been exploited. These are the following: Information that is represented by certain 3D objects, information that is displayed in 2D within the 3D environment (for example, slide presentations, images, computer monitors, etc.) and information in HTML format that is displayed in a new window and has nothing to do with the 3D environment (e.g. external resources, educational content units, educational composite units).

Access to VES web-site's functions

In order to give the possibility to the user to access the VES services through the mDVE, certain objects are used. These objects link to the services and can be activated by clicking on them. In this way pupils and students get acquainted with the VES system in a more friendly and interactive way.

Presentation of thematic material

The virtual environment provides an alternative way of finding educational content and educational composite units for a specific thematic area in the VES database. This way resembles a real life situation in order to be easy for the users. The thematic material is presented in the specified thematic rooms with the help of the bookshelves and the corresponding books.

Help

Certain help within the virtual worlds is provided to the users. By this, we mean all the assistant information that is represented in the 3D environment.
This help functionality exists in both worlds through the following:

- Navigational aids through several viewpoints and predefined tours. The user could be able to take a virtual tour that would guide him/her to the main functions of the virtual world.
- Hints. As the mouse passes over some objects it changes to a hand. Holding the mouse over, this object would display a tooltip giving to the user more information about the object.
- A help desk where is positioned an avatar resembling a secretary that when the user goes near, this avatar gives help hints in a speech bubble or a text label.

Animations

The 3D environment provides certain animations in order to be more attractive and interesting to explore. However, certain care was taken with the number and the functionality of them, because too many and complicated animations (e.g. walking people, sound players, etc.) can frustrate the user. In addition to this, it must be noted that the animations within a virtual world can increase the size of the file thus leading to long download times. Having this in mind the following animations are implemented and used:

- Slide presentation (maximum one in each virtual world)
- Moving humans that will assist the user in a certain way (maximum one in each virtual world)
- Predefined path – tour (maximum one in each virtual world).

Chat facility

Users can engage in real-time chat conversations, which are supported in various ways. Public chat allows one to speak or listen to everybody within a venue at the same time. Private chats can also be initiated anytime with other users. Members can also whisper quick private messages to other members.

Implementation Issues

Several issues have been considered in the development of the distributed virtual environments, in particular user interfaces and supporting architectures (see Bouras Ch., & Philopoulos, A. 1998, and Youngblut, Ch. 1998). In our case, through the development process we had to deal with several substantial technology related questions, e.g.: finding an appropriate compromise between the desire to design a sophisticated 3D environment and the demands (e.g. reasonable response time, minimum hardware and software needs for the user); creating solutions for the interaction of the virtual worlds and the databases of the VES system and the representation of the obtained information; integrating varied actions modes within the environment (e.g. wandering through 3D space, manipulating objects, browsing html pages or viewing content units). While designing the 3D Community the main issues that were taken into consideration are the creation of 3D worlds, the multi-user interaction and the user interface layout.

The creation of 3D worlds

The implementation of 3D worlds is based on Superscape VRT (see Bouras, Ch., et al. 1998, and Superscape) which is a 3D authoring studio for PCs. The 3D file format of VRT worlds is SVR, which is a compressed binary file that contains all the geometry, textures, sounds and behaviors needed for the interactive 3D world, in a highly compact and encoded form, giving short download times and rapid worlds start-up. The 3D browser that displays 3D worlds made with VRT on the WWW is called Viscape (see Superscape) and it is freely available as an ActiveX control for Microsoft Internet Explorer or plug-in for Netscape Navigator.

VRT has also a purpose-built behavioral control language, called Superscape Control Language (SCL) which is based on the C language. SCL is a compiled language and each program consists of a list of commands that are executed, in order, every frame. We use SCL to write simple programs that create links to other pages and add intelligence, animation and other specific behavior to objects. Furthermore, SCL gives us the ability to make HTTP requests to a web server and open files for reading or writing.

Multi-user interaction

The implementation of multi-user virtual environments is based on the use of blaxxun Community platform (see Blaxxun): blaxxun community server and blaxxun client. blaxxun Community Server consists of five software modules, and offers instant messaging, chat, message boards, calendars, 3D locations, 3D navigation, 3D and 2D avatars, friends lists, objects trading, agents, voice, homesteading, incentive systems, roles and access rights. Moreover, it includes administration interfaces that are required to operate and maintain the application.

Furthermore blaxxun Community Server is well suited for the implementation of mDVEs because it offers scalability, customizability, extensibility, and openness.

The main features of blaxxun community platform that are used in VES 3D community in combination with Superscape VRT are the representation and motion of avatars, the chat facility, and some shared events. For the implementation of shared events the "proximity" and "hit" events of Superscape VRT are used. With these events an event (e.g. animation) is triggered by a user in all other virtual environments.

User Interface Layout

An important issue in the design phase was how the whole mDVE application is combined with the existing interface of the VES system and how the user interface layout of the mDVE application looks like. After some proposed interface layouts and their evaluation from teachers, pupils and preceptors the implemented user interface layout is decided to be as depicted in the (Fig. 3).

This layout consists of the following frames:

- Frame 1: This frame could be used to display the top frame of the existing VES web site and give the user the ability to navigate within the available different services.
- Frame 2: Here is displayed a menu of the needed buttons for certain actions that have to do with the mDVE.
- Frame 3: Here is displayed the virtual world through the Viscape plug-in.
- Frame 4: This frame is used for the chat interface through the blaxxun plug-in.

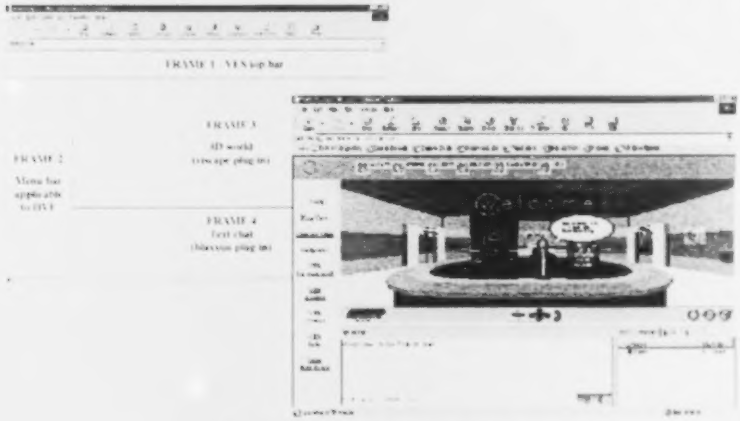

Figure 3: User Interface Layout

Conclusion

The described mDVE represents the result of our work to offer educational applications with the use of virtual environments. The development of this application has given us the opportunity to deal with many interesting technical issues, concerning the creation and usage of multi-user virtual environments. In addition to the technical issues that we have encountered, the educational issues that may come up while using this application may be even more interesting and help us use in a more efficient way the new ways of communication and interaction that distributed virtual reality technologies offer. In order to evaluate this environment, we have distributed evaluation sheets to teacher, pupils and schools.

Our next step in the process of developing this mDVE is the amendment of the current environment according to teachers and students evaluation results in order to a more suitable educational environment.

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The Eurydices System: Objectives and Services

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Abstract: In this paper, we present the objectives and the services of Eurydices, an extranet-based system aiming to teach virtual classes of geographically dispersed academic participants. Eurydices has unique features enabling it to cover efficiently all aspects of tele-training environments for the Greek Universities Network (GUNet). The system integrates an extranet with advanced distance learning applications offering on-line and off-line content delivery. In this way, the sense of collaboration among the participants is intensified. In total, compared to traditional distance learning tools the system's ultimate advantages will comprise its training efficiency as well as its ability to reach more students.

1 Introduction

It is widely recognized that there is an increasing need to improve training in modern society, and especially in higher education. Network technology and especially the WWW provides the potential to revolutionize training and education to the same degree as it has revolutionized access to information and communications for users around the globe (Shaw et al. 1996).

However, a number of issues need to be addressed if these technologies are to be applied successfully to deliver a positive and effective learning experience for students and learners in the academic context. New powerful and flexible solutions are required to deliver content and facilitate collaboration of University courses. The Intranet/Extranet technology provides the potential to foster the sense of community that is lacking in current distance learning applications. The creation of a more learner centric environment is certain to increase student success. Such learning environments bridge the gap from simple course delivering applications to CSCW systems for collaboration and team working. Although there are plenty of tools in the market for delivering and managing course material, the specific needs of the Greek Universities Network (GUNet) imposed the development of a new application, the Eurydices system (Tsakalidis et al., 1999; Bovilas et al. 2000). Eurydices should be fully tailored to serve needs such as:

- Efficient delivering of multimedia content,
- Integration of horizontal (general) and vertical (course-specific) content,
- Management of virtual classes,
- Seamless collaboration through advanced services tailored to specific needs

Each of these areas presents its own challenges in defining practical approaches and solutions, but without complete coverage, these issues can degrade the performance and return on investment in training technology. In this work we present an overall description of the Eurydices system. Section 2 describes the objectives of the system while section 3 analyzes the offered services. Finally, in section 4 we describe the future directions of our work.

2 Objectives

Our vision for distance learning is a seamless networked learning environment, which integrates all the advantages of an Extranet with an advanced distance learning application with on-line and off-line content delivery capability. The end user, GUNet is a large University network of 18 Greek Universities and 14 Technical Institutes connected through a high bandwidth line of about 34 Mbits. Members of this network have access to advanced telematic services ranging from Internet access to distance training with multimedia support. In the case of such a large academic network, partnership between institutions was offering a mutual benefit that could not be ignored. Additionally, the advanced network infrastructure made it possible to harness the potential of synchronous and asynchronous communication technologies to create powerful and learner-centered application for all members.

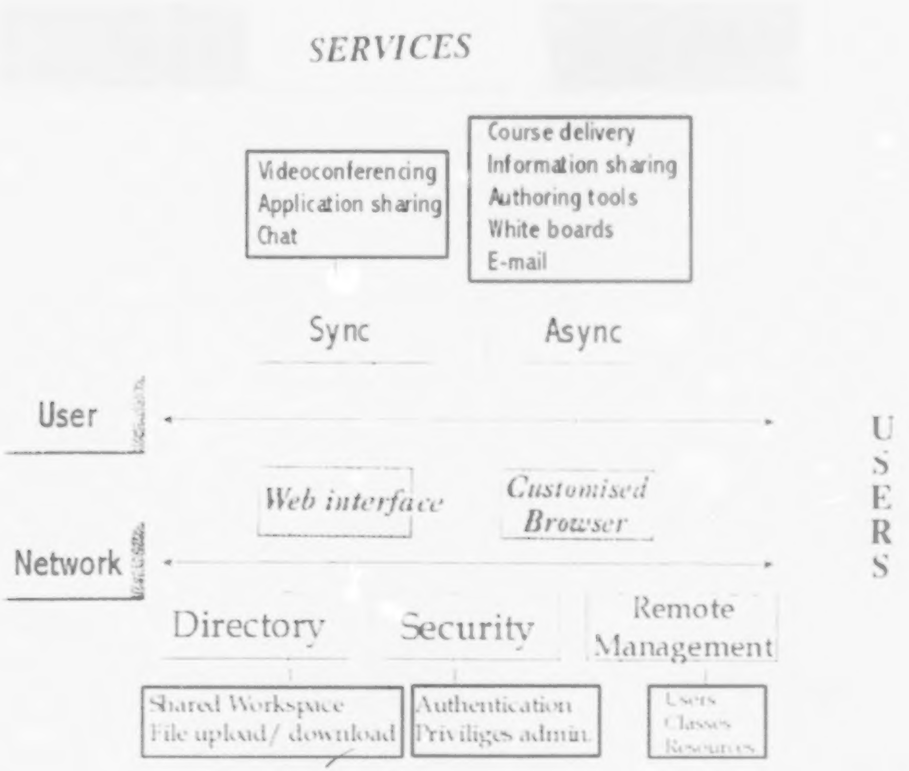
SERVICES
Videoconferencing
Application sharing
Chat
Course delivery
Information sharing
Authoring tools
White boards
E-mail
Sync
Async
User
Web interface
Customised Browser
Network
U S E R S
Directory
Security
Remote Management
Shared Workspace
File upload/ download
Authentication
Priviliges admin.
Users
Classes
Resources

Figure 1: Service categorization

The Eurydices system was designed to be the prototype of a networked learning environment that could make education and training more accessible, convenient, focused and effective for virtual classrooms across the network. The idea of creating an educational Extranet would create the possibility not only to deliver content but also to efficiently administer both user groups (virtual classrooms) and services.

More specifically, the objectives of the Eurydices system are to:

- take advantage of synchronous communication technologies, such as desktop video teleconferencing to enable live, real-time interaction between instructors and students,
- use asynchronous communication technologies, such as e-mail, databases, libraries, and the Internet, to support off-line interactions and access to information resources,
- use extranet technology in order to administer user and network services.

User services (see fig. 1) include:

- Information sharing and management – an instructor should be able to easily create and publish the latest course material for immediate use by the students,
- Navigation – finding information from any location within or from outside the network,
- Communication and Collaboration - accessing online discussion groups,

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- Access through a mix of computer platforms and operating systems, by using a common user interface.

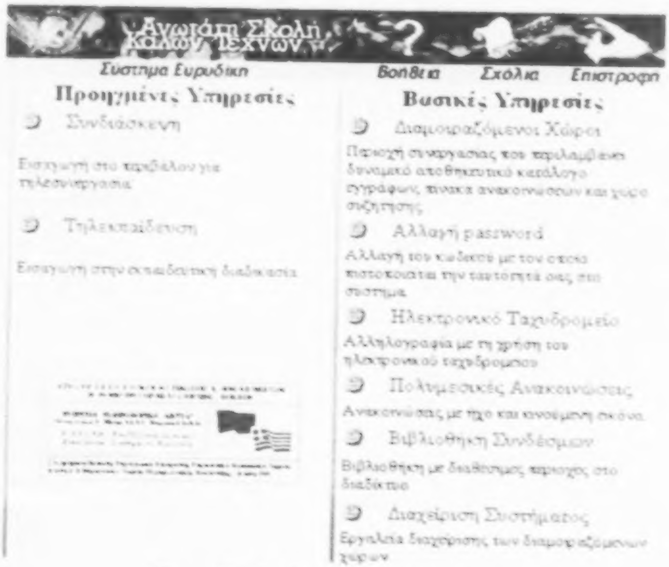
Network Services include:

- Directory - Administrators can centrally track and manage information about users and services.
- Security - Using authentication, information can be shared or protected as needed. An administrator can issue privileges for a project to virtual classroom members while protecting information from unauthorized use.
- Management - Administrators must be able to centrally and remotely manage all network resources.

Especially, the concept of virtual classrooms is difficult to accomplish especially when participants originate from different academic institutions and sometimes have different study interests. A significant part of the educational process should be the interaction with the instructor and other students. Students and instructors are used to classrooms, and they need to adjust their learning and teaching styles, respectively. For example, in one class, two students who work at different institutions can both share resources of the Extranet for a specific course. Additionally, each student can individually access resources in his University intranet. Through collaboration services these students should be able to exchange this additional information between them or with the whole class.

3 Main Features of the Application

The challenge was to implement the right combination of course delivery and extranet technologies to create an efficient networked learning environment (see fig. 2). This environment should be consistent with the mission of educational providers and learner expectations. The technology combination should also ensure that the strengths of one technology address the weaknesses of the other. We expect this ability to be improved in future versions of the system.



Προηγμένες Υπηρεσίες

Συνδιάσκεψη

Εισαγωγή στο περιβάλλον για τηλεσυνεργασία

Τηλεκπαίδευση

Εισαγωγή στην εκπαιδευτική διαδικασία

Βασικές Υπηρεσίες

Διαμοιραζόμενοι Χώροι

Περιοχή συνεργασίας που περιλαμβάνει δυναμικό αποθηκευτικό κατάλογο εγγράφων, πίνακα ανακοινώσεων και χώρο συζήτησης

Αλλαγή password

Αλλαγή του κωδικού με τον οποίο πιστοποιείται την ταυτότητά σας στο σύστημα

Ηλεκτρονικό Ταχυδρομείο

Αλληλογραφία με τη χρήση του ηλεκτρονικού ταχυδρομείου

Πολυμεσικές Ανακοινώσεις

Ανακοινώσεις με ήχο και κινούμενη εικόνα.

Βιβλιοθήκη Συνδέσμων

Βιβλιοθήκη με διαθέσιμες περιοχές στο διαδίκτυο

Διαχείριση Συστήματος

Εργαλεία διαχείρισης των διαμοιραζόμενων χώρων

Figure 2: The front page of the system

3.1 User Services

User services are divided into two categories namely synchronous and asynchronous services.

Asynchronous Services

- Information sharing and management. This service provides extensive mechanisms for delivering and authoring course content providing a user interface that fully facilitates the Greek language. It contains an environment which allows authors to construct courses on-line using a standard Web browser. Courses are

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constructed using tools, much like as documents are outlined in popular word processors. Additionally, courses can be modified, with entire new chapters added or removed.

- Efficient course delivery through the use of hypertext and multimedia technologies. The navigation scheme follows the hierarchical model where content is distributed in chapters, sections and subsections. On-line help is available via messages, thus making use of the system as simple as possible even for novice users.
- Fast Authoring. This feature allows authors to quickly and easily create courses. Courses can be refined over time, improving both the quality of course material and the content, and taking into account any changes in the subject matter. This provides a powerful and flexible system, which directly supports modularity, reusability and redundancy in course creation. Future versions will include the personalized course development feature. This feature will enable instructors to modify an individual student's coursework without affecting others in the class. For example, if a student is having difficulty in some area of a course and communicates this to an instructor, the instructor can assign additional background material to assist him.
- Testing. Exercises or tests are an invaluable aid to both the learner and the instructor. The service allows courseware authors to create tests that can be graded by an instructor.
- E-mail and multimedia announcements. Email is used primarily by instructors for broadcasting messages to class members, and by students sending out messages to their classmates. Multimedia announcements use video and audio messages which are posted in specific areas accessible only by class members.

Synchronous Services

Synchronous services are the key element for creating a sense of community to both students and instructors. The system provides a set of tools that enable user to interact with each other and share applications and resources. Synchronous services include videoconferencing, application sharing and chat tools. Especially, the videoconferencing support is the most effective mean of cooperation when used for lectures, student reports, and instructor-controlled discussion. The chat tools is used just like IRC. The application sharing is useful for presentations, both during class and project development and presentations. The whiteboard provides an easy way to sketch figures, just like a whiteboard would be used in a classroom lecture.

3.2 Network Service

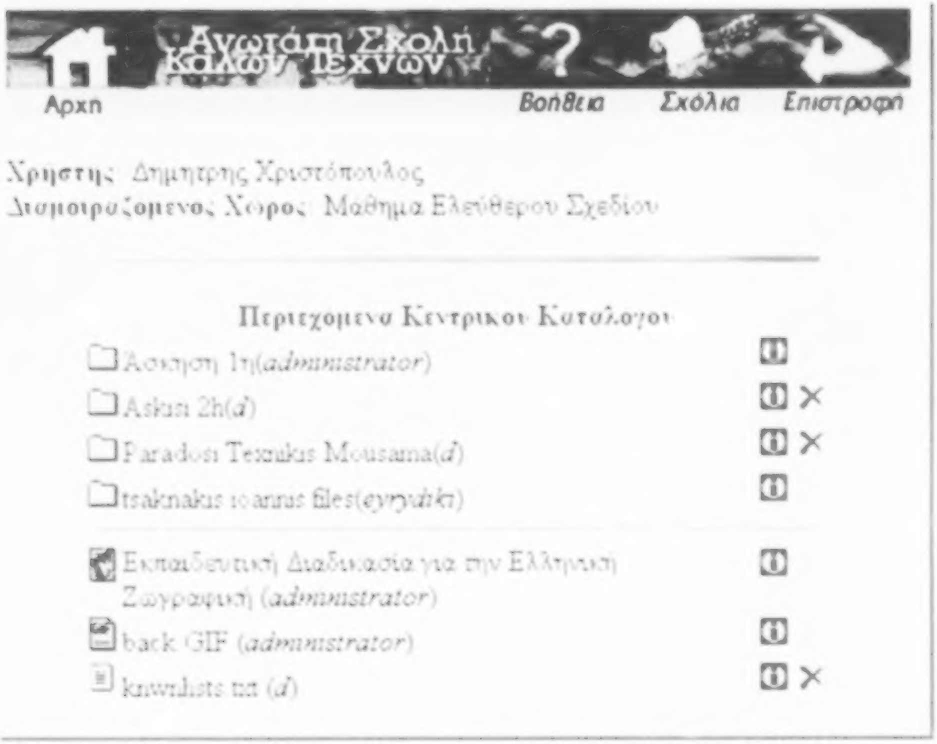
Network services include directory, security and remote management services.

- *Directory services:* This service manages a number of shared workspaces, that is a repository for shared information, accessible to members of virtual classes or individuals. The system has the ability to manage workspaces for different classes and work groups, while a user may be member of more than one workspace (e.g. one workspace for each course a student is involved with).

A shared workspace can contain different kinds of information such as documents, pictures, Web links to servers or FTP sites residing on the Internet etc. The contents of each workspace are represented as files arranged in folders (see fig.3). Each file is represented by an icon, which denotes the type of information contained in the file (e.g. file type, content description etc.). Access to information stored in a shared workspace is restricted to users who possess a valid login and password. The system uses an authentication server to obtain the identity of the user. Members of a shared workspace can also upload/download information from their computer to/from the workspace but cannot set rights to control which users have the permission to access this information or which operations (delete, modify) can be performed by them.

- *Security:* The main objective was to achieve a balance between securing the system and making it easy to use for all categories of end users. Complicated security procedures may discourage users from using the system thus decreasing its value as a teaching tool. Although it was important for the system to be as open as possible to end-users a number of security measures had to be taken:

- Confidentiality: verifying that parts of information is restricted to specific user groups and therefore accessed only by their members,
- Authentication: identifying users to ensure that the party attempting to access a given area is a member of the appropriate group,
- Integrity: verifying that information received (e.g. file upload) is the information that was put there by the originator,
- Access control: verifying that resources are under the control of the authorized parties and ensuring that the person attempting to access/modify them has the authority to do so.



Χρηστης: Δημητρης Χριστόπουλος
Διαμοιραζομενος Χωρος: Μαθημα Ελεύθερου Σχεδίου

Περιεχομενα Κεντρικου Καταλογου

- Άσκηση 1η(*administrator*)
- Askisi 2h(*d*) ✕
- Paradosi Texnikis Mousaima(*d*) ✕
- tsaknakis ioannis files(*eyrydiki*)
- Εκπαιδευτική Διαδικασία για την Ελληνική Ζωγραφική (*administrator*)
- back GIF (*administrator*)
- knwnlists txt (*d*) ✕

Figure 3: Managing the shared workspace

- *Remote Management:* this service enables the administrator of the system to grant /modify rights of users or user groups. The system addresses the following issues in relation with access rights:

- Application-oriented access rights. Support for various levels of workspace sharing.
- Flexibility and ease of use. Access rights depend on who is doing what and therefore are highly dynamic. The administrator can easily modify user or group rights depending on specific needs.
- Roles. Authorization is given to roles (e.g. instructors, students), rather than to individual users.

4 Conclusions and Future work

In this paper, we described the key features of Eurydices, an extranet-based system for course delivery and collaboration. This tool has some unique features, which are necessary in the demanding environment of Greek Universities. We plan to strengthen the services the system offers by incorporating techniques for discovering groups of students with similar interests or expertise. The techniques will make use only of the similarity between the accesses of the students to the web pages corresponding to different courses, ignoring the representation and the content of the information that is being accessed. This so called social recommendation approach is closely related to the collaborative filtering notion (see Goldberg et al. 1992) since it can be used to manipulate the flow of information from the system to the end-users in such a way that students being classified in the same group will get the same kind of information. We plan to implement the above service by using the spectral filtering method (see Chakrabarti 1998, Kleinberg 1998), a method that is closely related to the notion of a graph spectrum (see Chung 1998).

Future versions will be enhanced with more data and user management capabilities such as advanced session control

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and synchronous network services. Our final target is to develop a framework that will cover efficiently all aspects of tele-training environments for the Greek Universities network.

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Concept-Based Courseware Engineering for Large Scale Web-based Education

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Abstract: This paper describes a concept-based course maintenance system that we have developed for Carnegie Technology Education. The system can check the consistency and quality of a course at any moment of its life and also assist course developers in some routine operations. The core of this system is a refined approach to indexing the course material and a set of "scripts" for performing different operations.

1 Introduction

One of the major functions of a modern Web-based education (WBE) system is to store and deliver over the Web *the course content* (explanations, examples, quizzes, assignments, etc.). A large variety of course *support tools* and systems [Brusilovsky & Miller 2000; Robson 1999] is now available for creating, storing and delivering the course content. The problem that we are addressing in this paper, is that the vast majority of these tools is oriented implicitly to a *single author content development model*. In this model a syllabus and all course material is developed mainly by a single author in about the same way as a single-author textbook. Single author is usually able to develop a consistent course and update once a year to time without a serious loss of consistency. The situation with the large-scale Web-based education model that is emerging now is quite different. Large-scale modern courses includes hundred to thousands of learning items that are produced by a team of developers. Through the life of the course it could be updated and restructured several times to accommodate to the needs of different audiences. The difference between single-author and large-scale Web-based courses is a very similar to a difference between small programs developed by single programmer and large programming complexes developed by a team of software developers. Producing large-scale artifacts either programs or courses requires special support. Large software systems require the use of software engineering technologies and tools. Large-scale courses require the user of courseware engineering technologies and tools.

A special kind of courseware engineering tools is concept-based consistency maintenance tools. Consistency maintenance could be performed for a course where all learning items are extended with metadata that describes prerequisites and outcomes of every item in terms of *concepts*, *topics*, or *learning objectives*. The very idea is simple. A consistency checking mechanism can parse a course in the same order as a student and at any point check whether the "next step" is a good one. If the next step is not really good, it can report problems. For example, it can find a situation when an assessment requires knowledge that are not presented yet or, vice versa, when presented knowledge are never assessed. While these kinds of course checking seems too simple to require a special system they are absolutely necessary for any serious course developer teams such as Carnegie Technology Education, a WBE "arm" of Carnegie Mellon University. A concept-based course maintenance system is as important for courseware engineering as a version tracking system for software engineering.

This paper describes a concept-based course maintenance system that we have developed for Carnegie Technology Education. The system can check the consistency and quality of a course at any moment of its life and also assist course developers in some routine operations. The core of this system is a refined approach to indexing the course material and a set of "scripts" for performing different operations. Next section describes the indexing part and the section after that talks about scripts. We conclude with some speculation about prospects of our work.

2 What do we want from indexing

There are several possible ways to index the content from very advanced and powerful to very simple. The approach we choose supports the functionality that we find essential while being still simple enough to used by course developers.

Most of the existing indexing approaches are based on prerequisite-outcome concept indexing like the one used in Piano-Tutor [Capell & Dannenberg 1993] or InterBook [Brusilovsky, Eklund & Schwarz 1998]. Plain indexing does not distinguish different types of information items and different roles in which a concept can be involved in a learning item. It also does not take into account relationships between concepts. Plain indexing has shown to be useful in simple domains or with coarse-grain level of domain modeling. All systems with plain indexing known to the author use about 50 concepts and have homogeneous learning items (lessons, chapters, or pages).

The three major extension of plain indexing approach are introductions of item types, concept roles, and links between concepts. Item types let the system distinguish several types of indexable information items. Concept roles can specify different roles of the items in regard to concepts. Both mechanisms let the course developer specify more knowledge about the content and support more powerful checking algorithms. Item types are simpler and easier for indexing, however, it's mainly suitable for reasonably small information items that can be easily typed. Role-based indexing approach is more powerful – it can deal with cases where different concepts play different roles for same information item. It could be used with coarse-grain items. A few systems with exceptionally rich information space use both concept typing and role-based indexing. Inter-concept links is a serious advancement. Its major impact is a more precise student modeling, prerequisite tracking, and richer navigation. Negative side of it is hard authoring. Developing a connected concept model of a domain takes considerable time of several domain experts.

Since the major goal of indexing of CTE courses was the possibility to help course designers with developing and modifying courses, we were interested to represent as much information about items, as it is reasonable for the authors and decided to all extensions: types, roles, and links.

The core of our framework is concepts – elementary pieces of learning material. The size of a concept is not fixed and may depend of a course. We have several kinds of teaching operations in our courses – presentations, examples, assignments, and multiple-choice questions. The type of the item is a part of the index for the item. Concept-role pairs form the rest of the index. We use four kinds of roles (in comparison with only two in InterBook and Piano-Tutor): light prerequisite, strong prerequisite, light outcome and strong outcome. In comparison with "real" or strong prerequisites and outcomes that tells that "deep" knowledge of a concept are produced or demanded by a learning item, the light prerequisites and outcomes deal with surface knowledge about a concept. We have to introduce these four roles to accommodate the needs of real courses.

The course concepts are connected to form a heterarchy. We use one non-typed parent-child link. This link has to express the value usually expressed by "part-of" and "attribute-of" links. Creating a parent-child hierarchy without the need to type links is relatively easy. The meaning of this hierarchy is simple – the knowledge of a parent concept is a sum of knowledge of child concepts plus some "integration extra". There are two major uses of this parent-child heterarchy:

- A parent concept could replace a list of all child concepts in indexing (for any role). This will make the indexing more compact and easy in use.
- When monitoring individual students, the current level of knowledge of 30 higher-level concepts provides a better view on the student progress than the state of knowledge of 300 terminal-level concepts.

3 The use of indexing for courseware engineering

3.1 Prerequisite checking

Prerequisite checking is the one of the key benefits of concept indexing. It is important for original course design as well as for a redesign when learning items are moved or changed. With multiple-level indexing we are able to check prerequisites for all learning items. Prerequisite check for linear courses is performed by a sequencing engine that simulates the process of teaching with a student model. It scans learning items in the order specified by the author, updates the student model, and checks the match between the current state of the model and each following item. The following prerequisite problems could be checked:

- **Presentation prerequisites:** a presentation item can be understood because all prerequisite concepts are already presented up to the required level
- **Question prerequisites:** all concepts involved into all questions designed for a presentation page are learned at least up to the advanced level when the page is completed
- **Example prerequisites:** all concepts involved into an example are learned to the required level right in the section where an example is presented or before; strong prerequisite concepts are learned at least up to the advanced level, weak prerequisite concepts are learned at least up to the surface level
- **Exercise prerequisites:** at the point where an exercise is presented, all strong prerequisite concepts are learned and demonstrated with examples, all weak prerequisite concepts are at either learned or side-demonstrated with examples.

A failure to meet the prerequisites could mean either a problem with structure (the item that could meet the prerequisite does exist in the courses but placed after the checked item) or a problem with content (no item to cover the prerequisite). The system can distinguish these two cases and provide a helpful report of a problem. While the former problem could be often resolved by restructuring the material, the latter indicates a need to expand the course material.

3.2 Presentation and assessment

Question placement and repositioning

Well-designed quiz questions have one or two outcome concepts. Thus, the system can automatically place new questions into the proper topics by finding the section where the last of these concepts is presented in full. With automatic placement we can delegate course and question design to several authors and get a consistent course. If the course is re-structured the questions can be automatically repositioned.

Guidelines for question design

By matching concepts presented in a topic and concepts assessed by the topic's question pool it is easy to identify a set of concepts that can never be assessed. The identified deficit could drive the question design process. Same procedure can also ensure that the questions in the pool are reasonably evenly distributed among the concepts (to avoid the situation where 80% of questions are testing 20% of concepts).

Matching presentations with examples and exercises

It is possible to check to what extent examples and exercises matches their place in the course and to what extent they cover the presented content. It can be done by matching the set of concepts presented in the section with the joint sets of goal concepts of exercises and examples located in this section. In an ideal situation each section should present, demonstrate (by examples) and assess about the same sets of concepts. If there are too many concepts that are presented but not covered by examples or exercises, the coverage is low. If there are too many concepts that are covered by exercises or examples but not presented in the section (if there is no prerequisite conflict they could be simply presented in previous sections) then the relevance is low. Small mismatch between presentations, examples, and concepts is not a problem, but bigger mismatch in either direction is a sign of poorly designed section and an indication that something has to be redesigned.

3.3 Improving course quality

Consolidation of presentations

In a well-designed course each concept has to be presented in full in a single place (subsection or section). It is the place where the student will be returning to refill the gaps in his/her knowledge of a concept. This place is called the concept "host sections". A concept could be introduced before its host section (to enable the student to learn or practice other concepts) but not too many times (hardly more than twice) and not after the full presentation. The system can check these rules using indexing. (Note: The same is not true about examples. It's quite desirable to have several examples for each concept).

Presentation density and sectioning

While different concepts may require different amount of presentation, the overall complexity of a content fragment is proportional to the number of concepts presented in it. By controlling the number of concepts presented in each section we can identify two types of problems: presentation density, where too many concepts are presented in a relatively short section, and uneven distribution of content where number of concepts subsections of the same level.

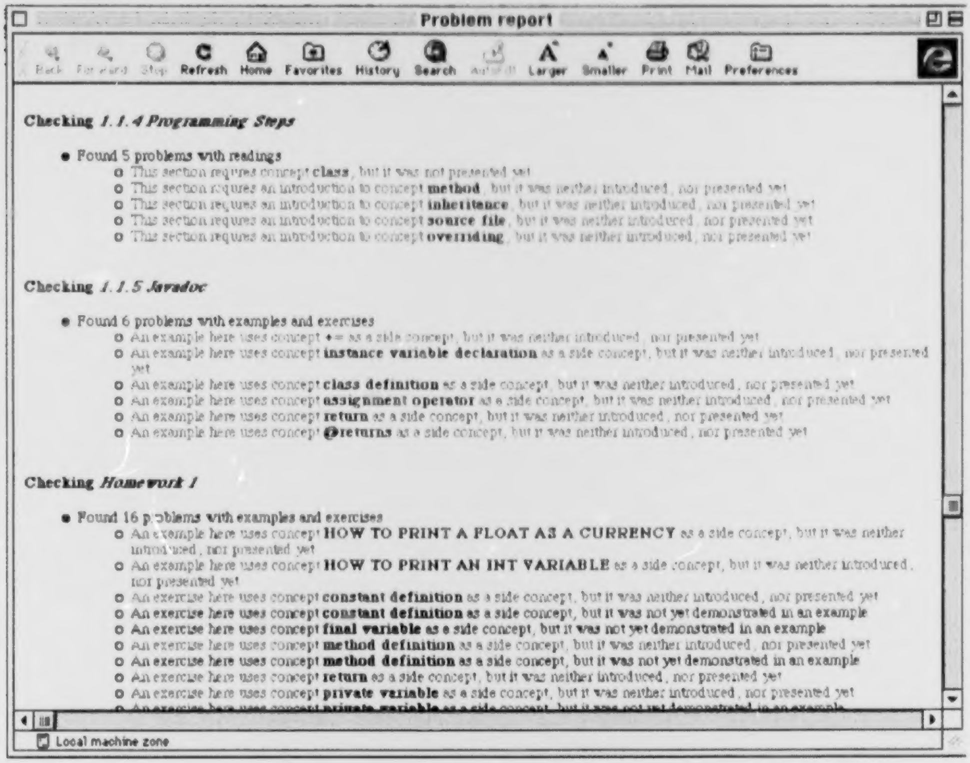
Controlling the difficulty of examples and exercises

Prerequisite indexing of exercises and examples specifies minimal requirements for the concept level that have to be met to make an example or an exercise ready to be taken. Its legal, however that some concepts have higher level of knowledge then it is prescribed. For example, a goal concept of an exercise has to be learned up to the advanced level. In real life, the student reaches this exercise when he or she has already seen several examples with this concept or even solved an exercise involving this concept. It makes this exercise easier for that student. Generally, we can estimate difficulty or learning item by measuring a difficulty between the target state of the goal concepts and the starting state. If all goal concepts or an exercise have been already applied in previous exercises, the exercise is quite simple. If none of them have even be used in examples, the exercise is very difficult. The difficulty of an exercise is not a constant – it depends on the place of the exercise in the course. It makes sense to control the difficulty of examples and exercises in the course to make sure that none example or exercise is too simple or too difficult.

There is research evidence that there exists an optimal difficulty of a learning item for each individual student (i.e., that the student learns best when he or she is presented with learning items with difficulty closed to optimal. We can't use this finding directly since our courses are static – all students go the same way. But in some future we can found that different groups of users can handle different difficulties. It could be used for making better-targeted courses for special categories of users.

Checking course design against the real course

An author could start the course design with a design document that lists all essential concepts to be introduced in each section. The design document could be stored separately from the course. The system can check how the real course matches the original design by comparing where the author planned to introduce the key concepts and where they are really introduced; how the set of target concepts is supported by questions, examples, and exercises.



Checking *1.1.4 Programming Steps*

- Found 5 problems with readings
    - This section requires concept **class**, but it was not presented yet
    - This section requires an introduction to concept **method**, but it was neither introduced, nor presented yet
    - This section requires an introduction to concept **inheritance**, but it was neither introduced, nor presented yet
    - This section requires an introduction to concept **source file**, but it was neither introduced, nor presented yet
    - This section requires an introduction to concept **overriding**, but it was neither introduced, nor presented yet

Checking *1.1.5 Javadoc*

- Found 6 problems with examples and exercises
    - An example here uses concept += as a side concept, but it was neither introduced, nor presented yet
    - An example here uses concept **instance variable declaration** as a side concept, but it was neither introduced, nor presented yet
    - An example here uses concept **class definition** as a side concept, but it was neither introduced, nor presented yet
    - An example here uses concept **assignment operator** as a side concept, but it was neither introduced, nor presented yet
    - An example here uses concept **return** as a side concept, but it was neither introduced, nor presented yet
    - An example here uses concept **@returns** as a side concept, but it was neither introduced, nor presented yet

Checking *Homework 1*

- Found 16 problems with examples and exercises
    - An example here uses concept **HOW TO PRINT A FLOAT AS A CURRENCY** as a side concept, but it was neither introduced, nor presented yet
    - An example here uses concept **HOW TO PRINT AN INT VARIABLE** as a side concept, but it was neither introduced, nor presented yet
    - An exercise here uses concept **constant definition** as a side concept, but it was neither introduced, nor presented yet
    - **An exercise here uses concept constant definition as a side concept, but it was not yet demonstrated in an example**
    - **An exercise here uses concept final variable as a side concept, but it was not yet demonstrated in an example**
    - An exercise here uses concept **method definition** as a side concept, but it was neither introduced, nor presented yet
    - **An exercise here uses concept method definition as a side concept, but it was not yet demonstrated in an example**
    - An exercise here uses concept **return** as a side concept, but it was neither introduced, nor presented yet
    - An exercise here uses concept **private variable** as a side concept, but it was neither introduced, nor presented yet
    - **An exercise here uses concept private variable as a side concept, but it was not yet demonstrated in an example**

Figure 1: A fragment of a problem report for a Java course

4 Current State and Prospects

The first version of the system was completed in 1999 and evaluated on one of CTE courses. With a help of the system we were able to find and fix a number of problems in the course. The system is written in Java and supports the following functions:

- Prerequisite checking
- Finding content "holes"
- Consolidation of presentations
- Question placement and repositioning

While the system turned out to be very useful, we have encountered a problem. In addition to a good number of real large and small problems the system has also reported a number of problems that no real teacher would count as a problem. It turned out that the course consistency rules behind the system are too rigid. In real life teachers can perfectly tolerate a number of small inconsistencies in the course. Moreover, in some cases the course may be formally "inconsistent" with a purpose. A teacher may want to provoke

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student thinking by presenting an example that is based on a material that is not yet presented but could be understood by analogy with the learned material. Our quick answer to this problem was color coding the course problem report (Figure 1). In particular, the messages that always report a real problem in the course are colored red not to be missed. The messages that report a problem that often may be tolerable are colored green. We use three to four colors in our reports. A real solution to this problem would be a more precise set of checking rules that is adapted to the course "teaching approach" and, probably, a better indexing.

We continue the work on the system. Our goal is to find the most useful ways for indexing and checking course material. At the moment the price of indexing a course may look too big for a benefit of being able to maintain course consistency and quality. However, we think that in the future concept-based course maintenance tools will be an important part of any courseware engineering system. The emerging standards on Learning Objects Metadata [IEEE LTCS WG12 2000] and on Computer-Managed Instruction [IEEE LTCS WG11 2000] are quite compatible with our prerequisite-outcome approach to course indexing. As soon as larger and larger amounts of indexed course material will become avaiable, the use of use of concept-based course maintenance tools will become cost-efficient not only for large course development powerhouses, but also for relatively small academic teams.

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Developing Web-based Tutoring Agents Using CORBA

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Abstract: An agent-based approach is used for the design and implementation of a Web-based learning environment in general chemistry laboratory domain. By taking advantage of the common object request broker architecture (CORBA), four kinds of agents are implemented: i) the student agent that models students' learning progress, ii) the expert agent that simulates domain expertise, iii) the intelligent tutoring agent that scaffolds students' problem-solving processes and the iv) adaptive lecture guidance (ALG) agent that presents students with adaptive navigation plan. The advantages of this approach are two-fold. First, the CORBA middleware provides the distributed communication infrastructure for agents to cooperate and to produce intelligent tutoring behaviors (ITB). ITB is a critical component to achieve learning efficiency in WWW environments. Second, the modular and platform independent characters of these agents bring the potential for cooperative development of reusable educational contents, which in turn provides a more cost-effective system.

Key words: *Agents, Web based Education, Intelligent Tutoring, Intelligent Learning Systems, General Chemistry Lab.*

1. Introduction

The recent advances of the Internet and the WWW have brought much attention to the world of WWW based intelligent learning environments (Brusilovsky, et al. 1996; Woolf, et al. 2000; Turoff, 1999, Cao-Bengu, 2000). Intelligent Learning Systems (ILS) has already proven themselves valuable in education and training (Anderson, et al. 1985; Corbett, et al. 2000). For example, Corbett (2000) claimed that it is possible to build computer tutors that are appropriately half as effective as human tutors. However, the development of an ILS is a very time-consuming and an expensive process (Jerinic, et al., 2000; Wu, et al. 1998). Building an ILS means significant cost , a big development team, and large computer resources. Thus, the ability to make them widely available and reusable at a low cost becomes very attractive.

To address this problem we employ recent advances in the standards for distributed object computing, and implement an agent-based approach for the development of a platform independent, reusable distributed intelligent learning tool. The remainder of this paper first presents an overview of CORBA, then discusses the general architecture of the system as well as the design of the agents, illustrates the implementation and finally offers a summary and conclusion.

2. Common Object Request Broker Architecture (CORBA)

CORBA represents a branch of the industry efforts toward developing distributed, portable and interoperable software components (Pope, 1997). It is a middleware specification developed by Object Management Group (OMG), a consortium of several hundreds of companies to facilitate distributed object computing. Four major parts are defined in CORBA: the object request broker (ORB), object services, common facilities, and application objects. Object services define the system-level frameworks necessary for any application to be constructed in a reasonably high level, including object life cycle, naming, event notification, persistence, transactions, and concurrency. Common facilities are application-oriented objects providing high level functionality that defines general capabilities required by many applications, including access to databases, printing files, document management, and e-mail. The ORB provides the basic object interaction capabilities necessary for communication among any of the components. It lets objects transparently make requests to and receive responses from other objects locally or remotely. Application objects represent the actual software being developed for solving domain-specific problems.

For developing CORBA-compliant application objects, developers need to specify the interface for each object by using CORBA Interface Definition Language (IDL). IDL is CORBA's object contract language. An Object's IDL defines it boundaries in terms of its contractual interfaces with potential objects. Since the OMG does specify mappings from CORBA IDL to various programming languages, including C, C++, SmallTalk, and Java, CORBA Objects written in IDL are portable across languages, operating systems, and networks.

CORBA IDL used here shows interfaces to expert agents, student modeler, the ITT, the ALG and other CORBA objects in the system. For example, the IDL code for the base interface of the expert agent is as follows:

```
interface ExpertBase {
        // Object ID
        readonly attribute string name;
        readonly attribute string definition;
        readonly attribute string extension;
        // primary methods of getting topic value
        string QUERY( in string topic ) ;
        //primary methods of setting topic value
        void DECIDE( in string topic , in string value ) ;
        // explain the process of finding the answer
        tutorContext EXPAIN( in string topic ) ;
        //Register Relationships the agent invloved
        void RegisterRelationsips in Relationship ao ) ;

};
```

The ExpertBase interface serves as the base interface that all expert agents inherit and implement. The ExpertBase interface defines general attributes like name, definition, and extension. It also defines QUERY, DECIDE, EXPLAIN, and RegisterRelationships methods, through which expert agents interact with an external environment.

3. System Overview

The system architecture is shown in Figure 1. It consists essentially of four components: 1) User Interface Components: they collectively define the web-based user interface. 2) Instructional Engine Component: this core component is responsible of generating context sensitive tutoring behaviors such as navigation and problem-solving coaching during the learning process. It consists of four major agents: intelligent tutoring tool (ITT), adaptive lecture Guidance (ALG), student modeler and expert agents. The ITT acts as a problem solving coach. It is composed of three modules: Current Problem Space, Blackboard, and Coach Delivery. Current problem space stores expert agents, which are initialized in terms of problem statements. These expert agents are expected to solve the questions collaboratively and generate a solution plan with activities on the Blackboard. Coach Delivery reads the solution plan and the activities from the blackboard, and sequences the coaching topics in terms of student knowledge status. ALG acts as student curriculum advisor; it passively responds to student request for help when it finds that the student does not know what is the next learning topic. 3) Repository Components provide facilities to establish the connectivity to data sources, to load and to store objects across distributed environments.

4) J-ORB refers to Java compatible CORBA middleware that mediates the transfer of messages from a program to an object located on a remote network hosts.

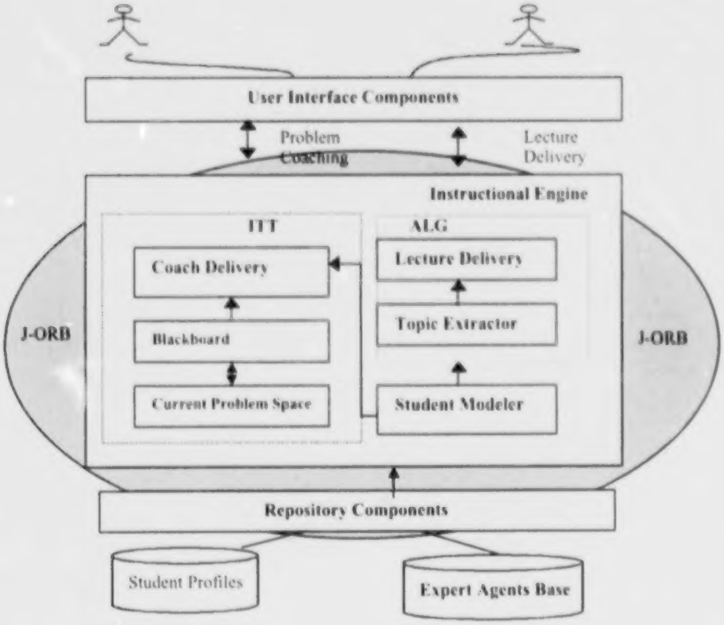
User Interface Components
Problem
Coaching
Lecture
Delivery
Instructional Engine
ITT
ALG
Coach Delivery
Blackboard
Current Problem Space
Lecture Delivery
Topic Extractor
Student Modeler
J-ORB
J-ORB
Repository Components
Student Profiles
Expert Agents Base

Figure. 1 System Architecture

3. Agent Organization

3.1 Expert Agents

The domain expert is a model of expert performance, including domain knowledge, problem-solving skill and rational explanation about knowledge element. Usually, knowledge domains are represented as semantic networks, or production rules or declarative and procedural knowledge in intelligent tutoring systems. (Wenger 1987). To facilitate the learning agent development, we adopt an agent-oriented knowledge schema for general chemistry domain. Agents are used for representing chemical substances and concepts. Associations like neutralization, alias, etc. is used to model regularities among chemical substances. In similar ways, the targeted general chemistry domain can be modeled as many inter-related expert agents of small domain topics..

Each domain expert agent consists of intelligence for solving problems of its topic and has social awareness of other expert agents. Related factual knowledge and procedural knowledge are captured as internal attributes or rules using a Java symbolic expression developed by Detlefs (1999). It also provides an interface for reading and setting the value of internal attributes and an interface for registering external associations with other expert agents.

An expert agent will answer queries addressed to it. When the value of the queried attribute is not available, it will first search and activate its action rules to set up sub-goals for solving it. If the expert agent can not solve a question addressed by self then it will actively originate requests for information through associations, which in turn request related information to other expert agents. The domain agent also possesses a self-explanatory capability. It is able to explain how the solution is achieved step by step.

3.2 Student Modeler

Student modeler constructs students' profile. It consists of two components: knowledge practice database and predictor. Each entry in the knowledge practice database is a record of the student's experience of a knowledge unit and can be represented as the following tuple: <KU, DL, TI, AR >, where: KU denotes the name of a particular knowledge unit, DL denotes the difficulty level of applying this knowledge in this practice, TI represents the time

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interval between previous practice and this practice, and AR denotes the results of this knowledge practice, a value of 1 means correct application while a value of -1 means failed application.

Predictor predicts a student's performance on a knowledge unit that is necessary for current problem solving process based on student's history. We assume that the older a knowledge practice is, the less impact it has on the student's current performance. If the Time Interval- TI of a knowledge practice is very large, its contribution is considered to be zero. However, if the TI of a knowledge practice is very small, which means the student practiced this knowledge a short time ago, it dominates the prediction. An empirical equation is used to calculate this prediction value.

3.3 ITT

The ITT is composed of three modules: Current Problem Space, Blackboard, and Coach Delivery. Current problem space is formalized into a pool of cooperative expert agents and questions.

Blackboard is a mechanism to record the cooperative problem solving processes (Jagannathan, et al. 1989). In ITT, it consists of two components: plan and activities.

The planning process is difficult and time consuming and is not our research concern. Instead, we take advantage of carefully designed questions, which are provided by human teacher or content provider, to form the solution plan and guide the cooperative problem solving process by expert agents. Therefore, each question becomes a phase in the solution plan.

Each phase in the solution plan is decomposed into a collection of related activities. As shown in Figure 2, each activity may be decomposed into a collection of related sub - activities. Therefore, for each phase in the solution plan, an activity tree is derived.

Coach delivery is the kernel of tutor. It comprehensively collects information from student modeler, and blackboard to produce intelligent tutoring behavior. The main algorithm for coach delivery component is as follows.

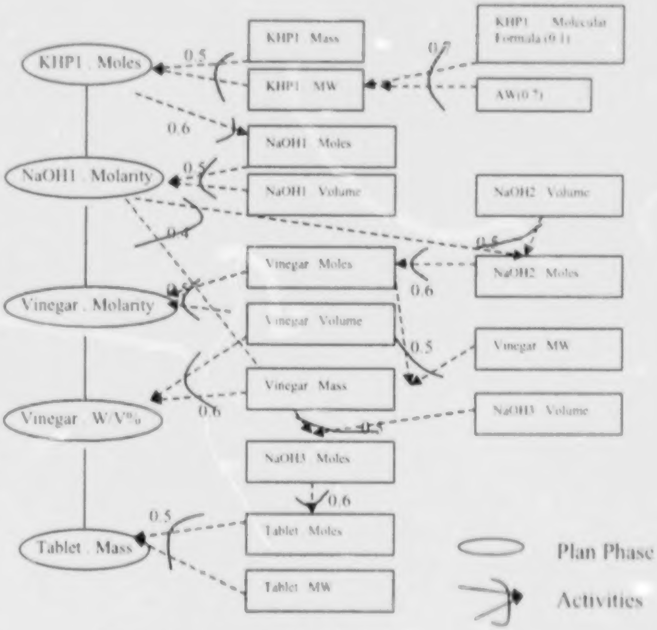

Figure 2. Annotated blackboard

1. Read the plan and the activities from blackboard.
2. Traverse activities, communicate with student modeler with corresponding student knowledge status and annotate each activity with the knowledge status value.
3. Identify which phase in the solution plan should be coached through interactive interface.
4. Sort activities of this solution phase according to their associated knowledge status value in ascending order.
5. Pick up the first activity for coaching dialogue to check if the student makes a mistake in it.
6. If the student has made a mistake, produce coaching and explanation, update student model, and encourage the student to continue to solve after understanding the explanations.
7. If the student has not made a mistake, update the student model and blackboard, delete the first activity from activity list, and go to step 5.

3.4 ALG

The ALG helps students to manage the complexity of navigating large hypermedia course materials. It serves as an advanced organizer that overviews and communicates expectations. Students are able to receive a navigation plan.

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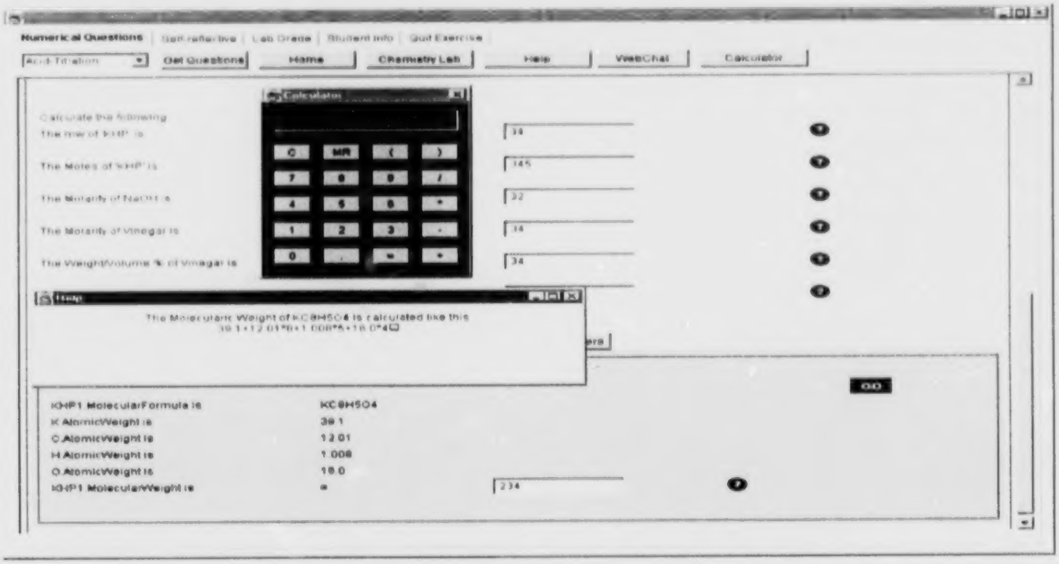
This navigation plan is sensitive to the student's current context and also based on their knowledge status. From it, students can know what is suggested for further study or what they need to go over to achieve their current objective.

4. Implementation in a General Chemistry Lab

We have implemented two prototypes in general chemistry laboratory, using above-mentioned system. Currently, several expert agents like Substance, Atom, Molecular, Acid, Base, NaOH, KHP and Vinegar, etc., together with the ITT, the ALG and the student modeler are developed. These agents are used for creating exercises for laboratory of "Analysis of Acidic Substances Titration" and laboratory of "Measuring the Density of a Solid and a Liquid". These agents run on Web-based computing environment. Java is used as the implementation language and CORBA compliant software is used as the broker for creating and managing agents.

Students interact with the agent through the user interface. The user interface is developed as a Java applet that students can access through Browsers. Students select problems and initiate further help requests through the interface. When a student selects a problem, the interface components request ORB to create a particular tutor agent on the particular problem. The problem is formatted and displayed in the user interface for the students to solve. On the other side, tutor agent begins to create current problem space, during which related expert agents are initiated according to SEM problem description and student modeler is created for the particular student. Problem solving goals are set up in terms of questions and expert agents begin to cooperatively solve the problem and record solution activities on the blackboard while the student is solving the question on the other remote side simultaneously.

Upon answering the questions, the answers are either marked with a□ tick indicating it is correct, or with ? indicating error□. The student can then initiate help requests through the interface to the tutor. The tutor locates solution activities that are collaboratively generated by expert agents and queries the student modeler on the status of knowledge applied in each activity. The tutor then applies the coach delivery algorithm to verify the student's solution steps. Figure 3 illustrates an intelligent tutoring scenario.



Calculate the following
The mw of KHP is 34
The Moles of KHP is 145
The Molarity of NaOH is 32
The Molarity of Vinegar is 14
The Weight/Volume % of Vinegar is 34

The Molecularit Weight of KC8H5O4 is calculated like this
39.1+12.01*8+1.008*5+16.0*4

KHP1 MolecularFormula is	KC8H5O4	
K AtomicWeight is	39.1	
C AtomicWeight is	12.01	
H AtomicWeight is	1.008	
O AtomicWeight is	16.0	
KHP1 MolecularWeight is	=	234

Figure 3 An intelligent tutoring scenario

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5. Conclusion

We introduced an agent approach to the development of a WWW based intelligent learning environment in general chemistry laboratory domain. The unique contribution of this study is that CORBA is adopted in the development of these agents. The interfaces of the agents are defined using IDL and implemented using Java. Our experience shows that these agents can be reused easily in creating several exercise problems for each laboratory. Given the platform independent character of CORBA, we believe these agents could also be used in other environments. Such an agent-based approach is valuable for the cooperative development of Web-based intelligent learning environments in the near future and eventually will be effective in reducing the cost of ILS development.

6. Acknowledgement

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COMPLEX KNOWLEDGE REPRESENTATION IN A WEB COURSE

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Abstract - Complex knowledge acquisition and transfer to new situations is always a difficult task to achieve. Cognitive Flexibility Theory principles are appropriate for complex domains and advanced knowledge acquisition. We apply CFT principles to a novel that is available on the World Wide Web. A Web course was conceived and is described on this paper. The reported research focuses on users' motivation to participate in this study, their comments about the analysis proposed to the novel and to the web course, and their opinion about web courses for further learning.

Introduction

Learning the introduction to a subject matter is not a difficult task, however, when we need to learn in depth about a particular knowledge domain, some difficulties arise due to conceptual complexity and increased ill-structuredness. Cognitive Flexibility Theory outlines a theory of learning and instruction for advanced knowledge acquisition in complex and ill-structured domains (Spiro et al., 1987, 1988, 1991a; 1991b; Spiro e Jehng, 1990). By ill-structuredness, Spiro et al. (1988) mean that many concepts interact contextually in a case and that their combination patterns are inconsistent across different case applications of the same type. Moreover, they mention that even where well-structured knowledge is involved, the context of its application is frequently ill-structured (Spiro et al., 1987). According to this statement, the ill-structuredness is an inherent characteristic of complex knowledge domain.

Advanced knowledge acquisition is the learning phase which follows the introductory one and it implies a deep understanding of content complexity. The learner must reason with it, and apply it flexibly in different contexts (Spiro et al., 1988). Thus, compartmentalizing knowledge, presenting clear instances, employing reproductive memory criteria, overreliance on a single basis for mental representation, on "top-down" processing, on context-independent conceptual representation, on precompiled knowledge structures, on rigid compartimentalization of knowledge components, and on passive transmission of knowledge all reduce important aspects of the complexity and are often in conflict with advanced knowledge learning (Spiro et al., 1988; Feltovich et al., 1993). Three major types of deficiencies in learning complex knowledge are widely recognized: misconceptions and incorrect knowledge, the inability to flexibly apply knowledge in new situations, and the lack of retention of knowledge that was previously acquired (Feltovich et al., 1993). New perspectives on instruction and assessment are required if education is to promote a deep understanding of complex and difficult subject matter. Cognitive Flexibility Theory emphasises the importance of successive presentations of the same material in rearranged instructional sequences and from different conceptual perspectives (Spiro e Jehng, 1990). To promote the mastery of complex knowledge and the ability to transfer that knowledge to new situations, Spiro et al. (1988) recommend several principles: avoidance of oversimplification and overregularization, multiple representations such as concepts and thematic perspectives, centrality of cases, conceptual knowledge as knowledge in use, schema assembly (from rigidity to flexibility), non-compartimentalization of concepts and cases (multiple interconnectedness), active participation, tutorial guidance and adjunct support for the management of complexity. A case represents specific knowledge pertaining to a context and it teaches a useful lesson when it exemplifies a new way of doing something or a new effect that is likely to be useful in later reasoning (Kolodner & Leake, 1996). Cases can come in many different shapes and sizes, covering large or small time slices (Spiro & Jehng, 1990; Kolodner & Leake, 1996). Cases need to be decomposed and represented along many partially overlapping dimensions, i.e., the same information must be represented in lots of different ways and many connections must be drawn across the decomposed cases, thus establishing many possible routes for future assembly (Spiro et al., 1987).

This theory generalises Wittgenstein's metaphor of the criss-crossed landscape (Spiro and Jehng, 1990). By criss-crossing conceptual landscapes the learner acquires interconnected knowledge structures that permit greater flexibility indispensable to apply knowledge to new situations. Flexible learning environments allow the same items of knowledge to be presented and learned in a variety of different ways and for a variety of different purposes.

Applying Cognitive Flexibility Theory to the novel "Cousin Basilio"

As the CFT is case-based, the first priority is to define or choose the *cases*. "Cousin Basilio" is a 19th century novel written by Eça de Queirós, a nineteen-century Portuguese author. We proceed to divide the novel into five cases. Each case has several small texts or *mini-cases* (tab. 1).

Chapters	Cases	Mini-cases	Novel Context	19th century Context	Thematic Commentaries
I - III	I	8	8	3	37
IV - V	II	7	7	4	37
VI - VII	III	6	6	4	35
VII - XIII	IV	9	9	5	36
XIV - XVI	V	4	4	2	15
Total	-	34	34	14	160

Table 1 – Components of the process of deconstruction of "Cousin Basilio" according to CFT

Each mini-case has to be decomposed or deconstructed according to several *themes*. We select nine themes that help the learner to attain a deeper understanding of the novel. Then, for each mini-case we select pertinent themes (from the nine themes) and a *thematic commentary* for each applied theme is written. Each commentary explains how that general theme applies to that particular mini-case. One hundred and sixty thematic commentaries' in all are written (tab. 1). Flexibility in applying knowledge depends on cases being disassembled so that they may later be adaptively reassembled (Spiro et al., 1987).

Consequently, criss-cross planning from case to case is important. "The notion of 'criss-crossing' from case to case in many directions, with many thematic dimensions serving as routes of traversal, is central to our theory" (Spiro et al., 1987: 187). The same content material is covered in different ways, at different times, in order to demonstrate the potential flexibility of use in that content (Spiro et al., 1988). This *thematic criss-crossing* is pre-defined to the user. A theme or a combination of themes is selected and the user is conducted through the mini-cases and thematic commentaries, acquiring a deeper understanding of the novel. "By criss-crossing topical/conceptual landscapes, highly interconnected, web-like knowledge structures are built that permit greater flexibility in the ways that knowledge can potentially be assembled for use in comprehension of problem solving" (Spiro & Jehng, 1990).

Spiro et al. (1987) suggest a cyclical alternation between thematic criss-crossing (in which cases illustrate or concretise the abstractions) and cases (in which the same abstractions are used in a combined form to describe the cases).

"Cousin Basilio" – Web site design

"Cousin Basilio: multiple thematic criss-crossings" is available on the web (on the following URL: http://www.iep.uminho.pt/primobasilio). The design of this document was directed by two main ideas, one related to CFT principles and the other to the recreation of the 19th century atmosphere in the web pages (Carvalho, 1999).

The web site is divided into three main areas (fig. 1): Menu1 and Main1, Menu2 and Main2, and Footer. Menu1 is the main menu, on the left-hand side, and on the right-hand side the content selected on the main menu, usually presents texts from the novel (fig. 2). Menu2 is the second menu which is a dynamic one and depends on the option selected on the main menu. On the main2 one can access the information selected on menu2 (fig. 2).

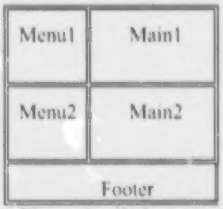

Figure 1 – Web site areas

In the Footer area, the user has the possibility to write his/her own Notes (click on the black pen), or to "Quit" the document (click on the three coins), and so on.

By accessing this document one finds an ancient book, which is interactive. By proceeding to Help (Ajuda) one may obtain information about the options available on both menus. All user information and instructions appear in blue, by means of a well-designed handwriting. Lastly, one is invited to write one's own name and password (this document is access free, however, the password is needed to save one's own Notes).

Figure 2 - Mini-case (main1) and Thematic commentary (main2)

The main menu (menu1) is always available with the following options: Cases, Oriented Thematic Criss-Crossings, Free Thematic Criss-Crossings (in which the user can search for cases and themes) and Table of Contents. The selected option on the main menu appears in red. On the main1, the texts of the novel have, as background, a light yellow page that resembles old stationery.

On the second menu (menu2) one is presented with the option to choose *Picture* or *Video* (which helps to recreate that particular time), one has also the option *Context* (the "Novel Context" gives information about the novel and the "19th century Context" gives information about some words related to furniture, transports, places, writers, operas, songs, and so on, that can be difficult for a 20th century student), *Thematic Commentaries* (which explain how each theme applies to that particular mini-case), *Themes* (a general description of each of the nine themes selected for analysing the novel), and *References* (authors already mentioned in "thematic commentaries" or in the general description of the Themes). The main2 background is blue (this resembles old official Portuguese stationery) and the text is sealed as a symbol of authenticity (fig.2).

Research Study

In previous research, we evaluated the Cognitive Flexibility Theory with regards to the importance of "Thematic Commentaries" and of "Oriented Thematic Criss-Crossings" on knowledge transfer to new situations (Carvalho & Dias, 1997; Carvalho, 1999). Results illustrated the importance of Thematic Commentaries on learning, i.e., the importance of the deconstruction process.

According to the results obtained (Carvalho & Dias, 1997; Carvalho, 1999), we may conclude that the document content and structure really help students to learn and to transfer knowledge to new situations. Consequently our present research focus is not on learning and knowledge transfer but on the users' characteristics, and on their reactions to the web document as well as to the structure of the course on distance learning.

Carvalho & Dias (1997) and Carvalho (1999) realised that autonomous learners enjoyed the challenge of constructing the answer to a given topic (like those of "Oriented Thematic Criss-Crossings", but this path was not available), by reflecting on the information available on the document. Thus, in this research we challenge the students, after visiting a "Case" and an "Oriented Thematic Criss-Crossing", to try to construct their thematic commentaries to the themes applied to a mini-case and to select the appropriate mini-cases to define a "traversal" through the novel, according to the topic presented at the "Oriented Thematic Criss-Crossing". After each one of these exercises, they are invited to check our paths. If learners accept this challenge they may get deeply involved and they may attain a better comprehension of the subject matter.

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Considering that further education is more and more demanding, we intend to analyse the subjects' reaction to this distance learning course by focusing on:

a) users' characteristics (computer literacy, Learning Preferences, motivation to participate in this study) and resultant implications on their opinions related to the following items:

b) users' opinions about the web document;

c) users' opinions about the structure of the web course on distance learning;

d) users' opinions about the inclusion of courses on the web during their undergraduate studies and for lifelong learning.

Course Structure and Pre-Requisites

As it is for advanced knowledge acquisition, this distance learning course on the Web establishes a pre-requisite with regards to the subjects' background: they have to be Portuguese literature undergraduate students or teachers of Portuguese literature.

They have to read the novel (450 pages) and to complete the tasks presented in the first package (see table 2). This first package includes a letter explaining the course structure, contacts, a "Learning Preferences Scale" (Carvalho 1998 & 1999) [1], a Questionnaire about subjects' computer literacy, and the pre-test.

Before starting the study			**Study and following sessions**		
Read the novel (450 p.)	**Package 1** letter	Session 0	**Package 2** Letter	**Package 3** letter	Report
	"Learning Prefer ences Scale"		Guidelines for sessions	Guidelines for sessions	
	Pre-test		Test	Post-test	
	uestionnaire on Comput literacy		Questionnaire of Opinion	Questionnaire of Opinion	

Table 2. Tasks to be achieved before, during, and after the course

After finishing the first package, subjects are asked to contact the researcher and to participate in a joint session (session 0, tab. 2), to be held in a computer laboratory at the university. The aim of this session is to help them feel comfortable to use and explore the web document. The subjects can contact the researcher by e-mail or by telephone at any time. It is not compulsory to send an e-mail, but it is recommended if they feel like sharing some ideas or raising some doubts.

At the end of session 0, they receive the second package which includes students' e-mail addresses, some guidelines for the following sessions, a knowledge test, and a Questionnaire of Opinion about the Web document.

The third package contains a letter with some explanations, indications for the sessions, a post-test, and a Questionnaire of Opinion. Finally, when they finish this study on the web, they have to write a report commenting on several aspects such as document design, the course structure, the quantity and the quality of the information available on the packages, and their opinions about courses on the web for university study and for further education.

We respected the pace and rythm of each subject; they started this study in April and the deadline to finish it was the 30th of June. Each time they submitted the content of a package, they received a new package.

Sample Characterisation

Nineteen 3rd year undergraduate students enrolled in Portuguese literature participated in this study, one male and eighteen females, volunteers, ranging from twenty to twenty nine years (the mode was 20 years and the mean was 22.5 years).

According to the information collected by the Questionnaire on Computer Literacy, only two subjects had never used a computer, all the others use it, but not often. Most of them had never explored an interactive environment such as CD-I (89.4%), CD-ROM (78.9%), or hypermedia (94.7%). Only six subjects (31.5%) had explored the Internet.

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[1] The "Learning Preferences Scale" has three dimensions: 'complex knowledge acquisition', 'autonomy in learning', and 'preference for complex knowledge'. This scale was developed based on the "Epistemological Learning Preference Instrument" (Jacobson, 1990), on the research of Schommer (1990, 1993), and of Jehng et al. (1993). The scale has been validated and data is available on Carvalho [1998 & 1999] (F1: alpha=0.83; F2: alpha=0.73; F3: alpha=0.63; the scale has a Cronbach's alpha =0.81).

Their attitude towards the computer was analysed according to two parameters: attitude (like, do not like, avoid) and feelings (comfortable, a little nervous, nervous), which are highly correlated (.71). Most of them (thirteen subjects), "like" to work with a computer, four subjects "don't like" and two "avoid" it. Fifteen subjects feel comfortable when they interact with a computer, two feel "a little nervous" and two feel "nervous".

Most subjects (15) feel comfortable when working with a computer, and eleven of them like to work with it, but four do not. The two subjects that feel "a little bit nervous" when they need to use a computer "like" to use it. Finally, the two subjects that feel nervous when using a computer "avoid" using it, but they neverthless accepted to participate in this research.

The results of the "Learning Preferences Scale" show that these subjects have a positive attitude[2] in all three dimensions. According to these results, subjects share the principles of Cognitive Flexibility Theory towards the acquisition of complex knowledge. With regards to the other dimensions, no one has a negative attitude, however, some have an indefinite attitude: five subjects in the second dimension "autonomy in learning" and eight subjects in the third dimension "preference for complex knowledge".

Subjects mention different kinds of motivation to participate in this study and several subjects (ten) refer to more than one motive. The most referred motive is to participate in a Web course on distance learning (fifteen subjects), the second one focuses on their interest in literary work (seven subjects), and the third one points out their interest in Eça de Queirós' literary work (five subjects).

Results and Discussion

The subjects did a pre-test before session 0 and a post-test after finishing the exploration of the web document. As the number of subjects was small (19), non-parametrics tests had to be used and the accepted significant level was alpha =.05. Tests were scored from zero to twenty. The mean obtained in the pre-test was 5.99 and the mean in the the post-test was 11.74. Subjects learned significantly from the pre-test to the post-test, p=.0002, according to Wilcoxon signed-rank test (Z corrected for ties: -3.724).

Users opinions about the web document

Several aspects were asked concerning the web document, such as, facility in learning how to use it, orientation in the document, path preference, involvement experienced, themes selected, influence of the document structure on learning, and its interface design.

Eleven subjects considered the web document "accessible to learn how to use" and eight subjects considered it "easy". During this study, they were asked three times about their *orientation* in the web document.

On the first session, 11 subjects felt comfortable, seven were disoriented, and one did not answer. On the following sessions[3], they improved their orientation. We think that this result can be explained by the acquired experience in the web document during sessions.

When asked about their path preference on the web document, the majority of subjects (57.8%), stated that they preferred the path "Cases", along all sessions. Surprisingly, 20% of subjects mentioned that they preferred all paths because "all of them are very appealing. All of them are important!"

They considered this study on the web "interesting" or "pleasant", and no one marked it as boring or frustrating, on the Questionnaire of Opinion. They felt actively involved in this study, both intellectually and physically (94.7%). Only one subject mentioned that she had been involved in a passive activity.

The selection of "Themes" has been indicated as adequate by all subjects, except one who considered it partially adequate. The reading proposed to the novel has been approved, sixteen subjects considered it "interesting" and three subjects found it "acceptable".

They considered that the structure of the document facilitates the comprehension of the novel (84.2%). They liked the web document interface, particularly the cohesion on the pages design recreating the 19th century. "The use of sealed stamps on a blue background as authentic text information, the black pen to write the notes, the coins, and the ancient book on the home site help to recreate a romantic and nostalgic atmosphere, that enhance the characteristics of the novel "Cousin Basilio". Theses details are more than just an ornament, they emphasise the ambience of the last years of the 19th century".

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[2] The attitude is positive if 3.5 and 5, the attitude is indefinite if 2.5 and 3.5, and the attitude is negative if 1 and 2.5 [Carvalho, 1998 & 1999]. The Likert's scale used has 5 points.

[3] At the end of package 2, 16 subjects felt comfortable, 2 were disoriented, and 1 didn't answer. At the end of the study, 18 subjects felt comfortable and only one felt disoriented.

Users' opinions about the structure of the course on distance learning

Twelve subjects (two had never used a computer) reported that session 0, where the researcher explained the function of all options and paths, was indispensable. Seven subjects considered that the information available on "Help" (Ajuda) is clear enough to explore the document easily.

All guidelines and tasks to be achieved were considered appropriate and clear. "The table [on the guidelines sheet for the session] to be completed on each session about visited mini-cases, contexts, and thematic commentaries helps greatly on the document exploration".

Subjects were invited both to construct the possible explanations of the applied themes to each text in the path "Cases" and to select the texts that support a given "Topic" as mentioned previously. Only four subjects accepted this challenge during all sessions, although ten subjects accepted it the first time it was suggested. Eight subjects argued that they didn't have enough time to do it. Some of the subjects who accepted that challenge said that "it promotes a deeper study", another one mentioned that she "realised that, when trying to explain *thematic commentaries*, some of her ideas were wrong, but others only needed to be completed". The majority of subjects that accepted this challenge had a positive attitude towards "autonomy in learning" of the "Learning Preferences Scale".

Some mentioned that a few times the access to the web was very slow and they felt that it was boring to wait for the links.

Users' opinions about other courses on the web during their undergraduate studies and for lifelong learning

All users positively accepted the idea of having documents like "Cousin Basilio" on the web, as a support to their learning modules in the university.

They also had a very favourable opinion about courses like this one on the web for lifelong learning (74%). When asked about their preference for (i) distance learning on the web or (ii) a mixed course that works partially in a room with students and teacher (particularly at the beginning, when everybody knows each other and learns how to use the web course information) and partially on the web. Some subjects preferred to do everything through the web (26%), others did not answer this question (11%), but the majority of the subjects preferred a combination of face-to-face meetings and distance learning on the web (63%).

Conclusion

Although the subjects' computer literacy was low, they felt it was easy to use the web document and to navigate on it. In order to achieve such favourable opinion as they reported, particular attention was given to the session zero in the laboratory, to help all users with different backgrounds to feel comfortable with the structure of the web document.

Only a few subjects accepted the challenge to build their own knowledge and then to verify it. However, the majority of those subjects that accepted the challenge have a positive attitude towards the "autonomy in learning" of the "Learning Preferences Scale".

The users liked the web document design and structure, and they considered this study pleasant. They accepted in a positive manner the idea of having documents like this one to support their modules at the university. They were also receptive to the idea of being enrolled in distance learning on the web for further learning. However, the majority of learners preferred a combination of a face-to-face meetings and distance learning on the web.

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Spiro, R., Feltovich, P.J., Jacobson, M. and Coulson, R. (1991a) Cognitive Flexibility, Constructivism, and Hypertext: random access instruction for advanced knowledge acquisition in ill-structured domains. *Educational Technology*, 31, 5, 24-33.

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TopBlend: An Efficient Implementation of HtmlDiff in Java

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Abstract: The World Wide Web is growing rapidly with new and changing web content. Detecting changes in web pages is crucial for website masters who care about website integrity. It is also convenient for web surfers who are constantly looking for new products, services, or information. This paper describes TopBlend, a new HTML differencing tool implemented in Java. TopBlend uses the fast Jacobson-Vo algorithm, which solves the Heaviest Common Subsequence problem, for page comparison. Performance results indicate that TopBlend significantly outperforms a previous HTML differencing tool in most time-consuming jobs, often by 1-2 orders of magnitude. TopBlend allows comparisons to be performed either on the server or client side, and can present the results in either a merged HTML view or a more convenient side-by-side view for web pages with complex graphics designs.

Introduction

Viewing the differences between web pages can be useful in many contexts. A web site maintainer might compare the new version of a page with the one available on the public site, in order to identify what has changed. By scanning just the changes, one can be sure the page is consistent with any policies for content or format without having to review the entire page at the same level of detail. A user of the web might identify the way a particular page has changed since it was last viewed (Douglis et al. 1998). For example, consumers can use the technology to monitor new products, services or auctions on E-commerce websites.

HtmlDiff (Ball and Douglis 1996) is a program to display the differences between pages. An initial version of HtmlDiff was written in SML of NJ, using the LCS comparison algorithm that was described by (Hirschberg 1977) and is used in the well-known UNIX `diff` program. Unfortunately, it had some shortcomings:

- It proved to be computationally expensive, for example taking over 3 minutes on a 200MHz Sun Ultra 1 to compare two similar 100-Kbyte files with about 800 anchors and 4000 words (Douglis et al. 1998).
- It displayed the differences between two HTML files as a "merged" page, marking up the newer page in place with font changes to highlight the differences from the older page. While this worked well in some cases, it often resulted in an aesthetically unpleasing display. Also, as a "derivative work" based on the newer page, it required that whoever generated the differences hold the copyright to the work. Side-by-side display of the old and new pages provides an alternative to this approach.
- It ran only on a single machine on which SML and HtmlDiff were installed, so it was not scalable to a large community of users. In contrast, a Java applet could be shipped to execute on an individual user's machine.

We therefore chose to reimplement HtmlDiff using (1) Java, (2) a more recent comparison algorithm developed by (Jacobson and Vo 1992) and (3) side-by-side display of differences. We refer to the new implementation as *TopBlend* [1]. In this paper we report the design and implementation of TopBlend, and an empirical analysis of its performance by comparison to the SML version of HtmlDiff. An extended version of this paper (Chen et al. 2000) provides additional information that has been omitted due to space constraints.

Background

This work is part of the AT&T Internet Difference Engine (AIDE), which is a tool for tracking and viewing changes on the web (Douglis et al. 1998). AIDE permits users to provide URLs of pages of interest, which it then checks for changes. It archives versions of pages users see, either upon an explicit request or more commonly by saving each new version as it becomes available and then recording which versions a user actually sees. By default, a user is shown the differences between the current version of a page and the last version seen by the user.

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[1] The name TopBlend was selected in homage to Peet's coffee, a prominent venue in Berkeley, California, where two of the authors did graduate studies. It is selected in keeping with the common practice of naming Java-based systems in a coffee genre, while recognizing the effect of blending two versions of a page together.

As a result of AIDE's automatic archival, we have a repository of about 750 Mbytes of web pages, consisting of 7600 URLs over a period of 4 years. Of these URLs, about 1700 are currently being tracked for changes. The mean number of versions per page is 22. It is important to note that these pages are not representative of the web as a whole. Most of these pages have been selected explicitly by one or more users within AT&T Labs-Research for tracking; therefore, they are skewed toward academic research pages, conferences, personal home pages, and the like. However, a sizable fraction of the pages in the repository were archived by a project that performed random sampling of the web, using URLs that were obtained at random from the AltaVista search engine. Most of these pages are regular HTML pages and are suitable for comparison with TopBlend or HtmlDiff.

Given that the pages in the archive *are* representative of the set of pages HtmlDiff compares when used within AIDE, indications that TopBlend executes more efficiently than "HtmlDiff classic" suggest that AIDE users can benefit considerably from improved performance.

Related Work

A number of systems are now available to track when pages are modified ((URL-minder 1996) appears to be the most widely known example), but most of them do not tell in detail *how* a particular page has changed. We are only aware of a few systems that support the comparison of web pages at the HTML level. One is AIDE; another is WebBeholder (Saeyor & Ishizuka 1998), which also uses an HtmlDiff-like tool and an agent community to find and display changes on the World Wide Web; and the last is WebIntegrity (Mortice Kern Systems 1997), which displays the differences between two versions of a page on a site, using frames to display the old and new versions side-by-side. Elliot Berk of Princeton University reimplemented HtmlDiff in Java (Berk 1996), again using Hirschberg's algorithm, but the prototype was not fully functional (Douglis et al. 1998). Like Hirschberg's algorithm, the Jacobson-Vo algorithm we adopted is worst-case quadratic time, but the Jacobson-Vo algorithm has the nice property that the worst cases are very unusual and it typically will run in linear time.

Human-readable comparisons of HTML pages are one way to represent the differences between versions. Another way is a binary-level comparison, which will typically run faster and encode more efficiently. In this study, we use Vo's `vdelta` program (Korn & Vo 1995) to compute a delta-encoding of two versions of a page for the purpose of comparing TopBlend's performance with a best-case binary-level comparison.

Architecture Of Topblend

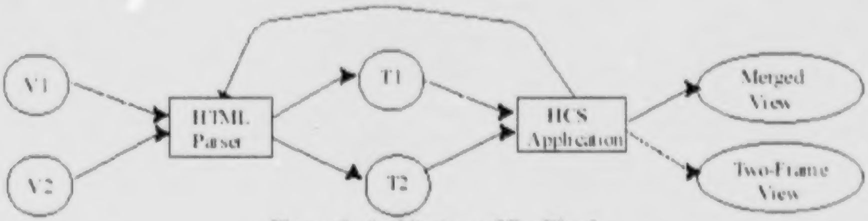


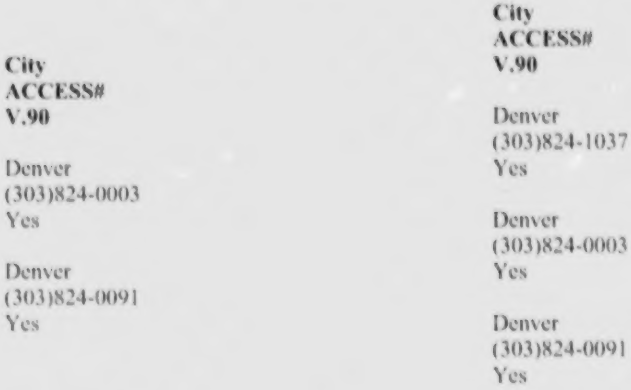
Figure 1: Architecture of TopBlend

TopBlend has two major components (Fig. 1), an HTML parser and an application of the Jacobson-Vo algorithm for the HCS (Heaviest Increasing/Common Subsequence) problem (Jacobson & Vo 1992). The parser breaks down each HTML file into a set of blocks according to HTML tags and emits a token sequence. The HCS algorithm compares the two token sequences generated by the parser and outputs the difference information in either a single merged HTML file or a frame view for side-by-side comparison.

HTML Parser

One of the main goals of TopBlend is to respect the HTML structure as much as possible so that it does not compare text across structure boundaries. For example, consider an example (Fig. 2) that consists of an old table and a new table. The latter adds a new row to the former.

If a tool simply divides the HTML file into a sequence of tokens without considering the table structure, then it may mistakenly mark the insertion as crossing two rows, as shown in the left table of the next example (Fig. 3). This is because the first "Denver" token is mistakenly matched across the first old row and the new row. On the other hand, if a tool matches by table rows before matching within rows, then we get the correct table shown in the right side (Fig. 3). This presentation, which TopBlend produces, is more consistent with a user's intuition.



City
ACCESS#
V.90

Denver
(303)824-0003
Yes

Denver
(303)824-0091
Yes

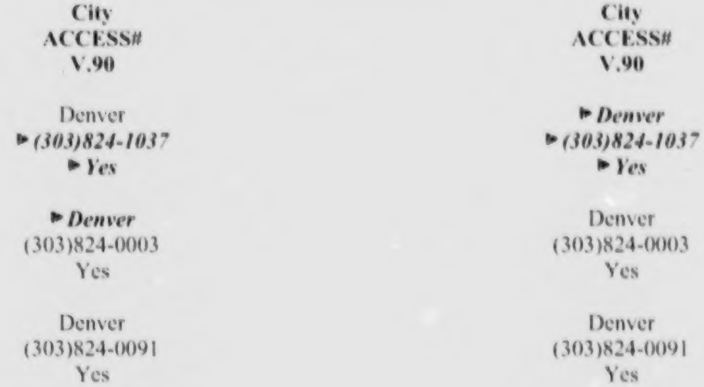
City
ACCESS#
V.90

Denver
(303)824-1037
Yes

Denver
(303)824-0003
Yes

Denver
(303)824-0091
Yes

Figure 2: WorldNet Access Numbers for Denver: Old and New



City
ACCESS#
V.90

Denver
▶ ***(303)824-1037***
▶ ***Yes***

▶ ***Denver***
(303)824-0003
Yes

Denver
(303)824-0091
Yes

City
ACCESS#
V.90

▶ ***Denver***
▶ ***(303)824-1037***
▶ ***Yes***

Denver
(303)824-0003
Yes

Denver
(303)824-0091
Yes

Figure 3: Comparison Results: Misleading Output and More Intuitive Output

In order to preserve the original HTML structure, the HTML parser classifies the HTML tags into three types:

Intact tag: The content between the starting tag and the ending tag of this category is considered a single unit even if there are other tags inside the block. Examples include table tags like <*tr*> and </*tr*> and list tags like <*li*> and </*li*>.

Ignored tag: The content between the starting tag and the ending tag of this category will not be compared or broken down further. Examples include (a) an HTML comment, (b) HTML content that cannot be compared visually, such as choice menus (<*select*>), (c) Non-HTML code that the parser cannot handle, such as scripts and Java applets.

Simple tag: All other tags. Plain text between such a tag and the next tag is considered a unit for comparison.

The HCS algorithm

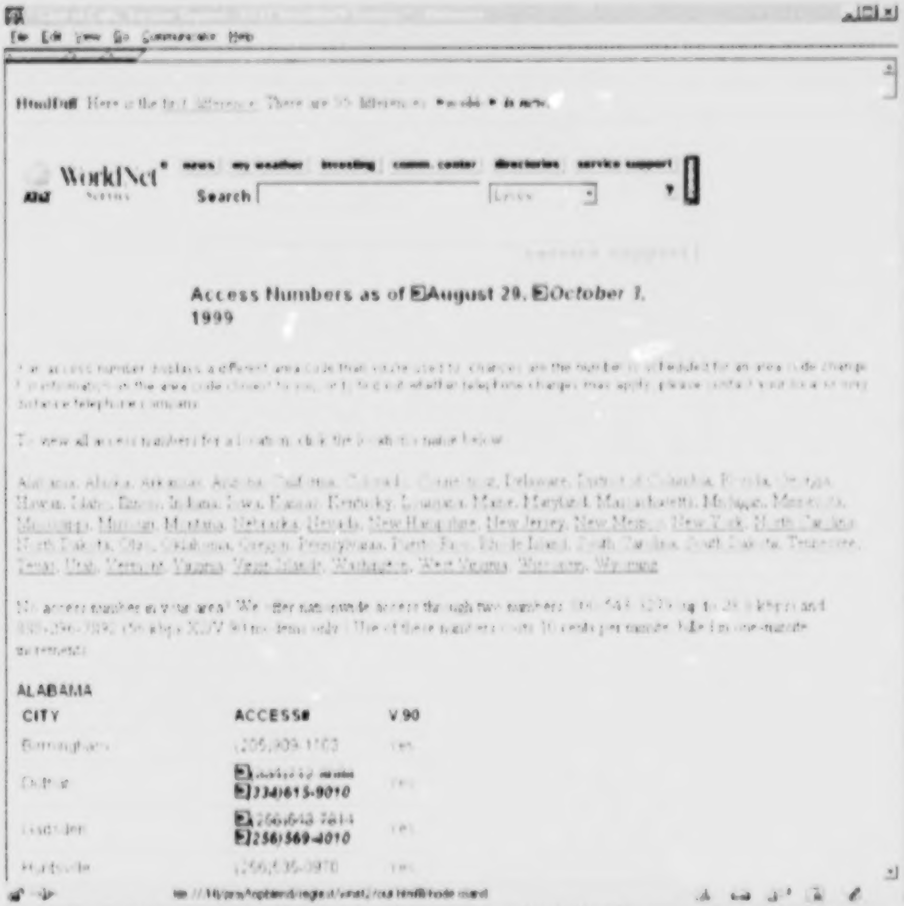
The heart of the TopBlend system is a Java implementation of the Jacobson-Vo algorithm that solves a generalization of the longest common subsequence (LCS) problem. The line-matching algorithm of the well-known Unix command `diff` is based on computing an LCS between the sequences of lines of text of two given files. Unmatched lines are insertions and deletions. Since LCS is based only on matching symbols, the `diff`'s line matching algorithm cannot take advantage of line lengths or approximately matched lines when determining line insertions and deletions. (Jacobson & Vo 1992) discussed how to include weights when matching symbols. In the most general case, weights can be associated to both symbols and their locations in the sequences being matched. Therefore, the Jacobson-Vo algorithm is capable of solving the *heaviest* common subsequence (HCS) problem.

In TopBlend, there are three stages in applying the HCS algorithm. At every stage, the checksum of each token (computed from its string content), rather than the string itself, is used for comparison to improve performance.

The HTML parser first breaks the two HTML files into sequences of blocks divided by the tags of the immediate children of the *<BODY>* tag. A token at this stage is either a first-level tag or a block between two first-level tags. All these tags share the same weight, which is the size of the html file. The weight of each block is the block length. The HCS algorithm is then used to find the heaviest common subsequence between these two sequences. This allows us to quickly identify chunks of identical text within the HTML first-level structure.

After that, it applies the HTML parser again, step by step, to break up each block (if there is any) between every pair of consecutive, matched tokens in the first stage. The parser breaks each block into a set of tokens, with each token representing either an intact block, an ignored block, or a simple block. The HCS algorithm is then applied to detect the longest common sequence of these block tokens based on their checksums.

Finally, it applies the HTML parser again, step by step, to each section of simple tokens (words, tags, etc.) between every pair of consecutive, matched block tokens in the second stage. At this point, the parser simply breaks up the intact blocks and simple blocks into a stream of simple tokens, while leaving each ignored block as it is. TopBlend then invokes the HCS algorithm again on these subsequences.



Access Numbers as of August 29, October 1, 1999

ALABAMA

CITY	ACCESS#	V.90
Birmingham	(205)909-1103	Yes
Dothan	[illegible] (334)615-9010	Yes
Gadsden	(256)543-7814 (256)569-4010	Yes
Huntsville	(256)535-0970	Yes

Figure 4: Merged View: Differences between Two WorldNet Pages on Access Numbers

TopBlend Views

TopBlend has a simple command line interface that takes two input HTML files and generates a specified output file in either the merged view or two-frame view. As an example (Fig. 4), we show the merged changes in the AT&T WorldNet access number list from August 29, 1999 to October 3, 1999. There are 55 differences and each is marked with an anchor that takes one to the next. New or changed entries in tables such as this, organization charts, or product catalogs can best be spotted using merged views. On the other hand, when a page has complex layouts with embedded images, it is usually better to use the frame view (Fig. 5). Here, the top frame shows the list of differences, the lower left frame shows the new page with new text highlighted in pink, and the lower right frame shows the old page with the old text dimmed in gray. The frame view clearly shows some textual changes, as well as making some changes to images apparent (though they are not marked explicitly.

Performance

To evaluate the performance of TopBlend relative to HtmlDiff, we ran a series of benchmarks using the AIDE archive. We selected 500 pages for which at least five versions were available, and extracted the most recent five versions from the archive. We then did pair-wise comparisons of successive versions (<N-4,N-3>,<N-3,N-2>,<N-2,N-1>, and <N-1,N>, where N is the highest version number of the page in the archive). In each case we ran a set of comparison programs on the aforementioned Sun Ultra 1, with 256 MBytes of DRAM, and minimal other applications executing. Because many individual executions took minutes or even hours, we did not repeat identical

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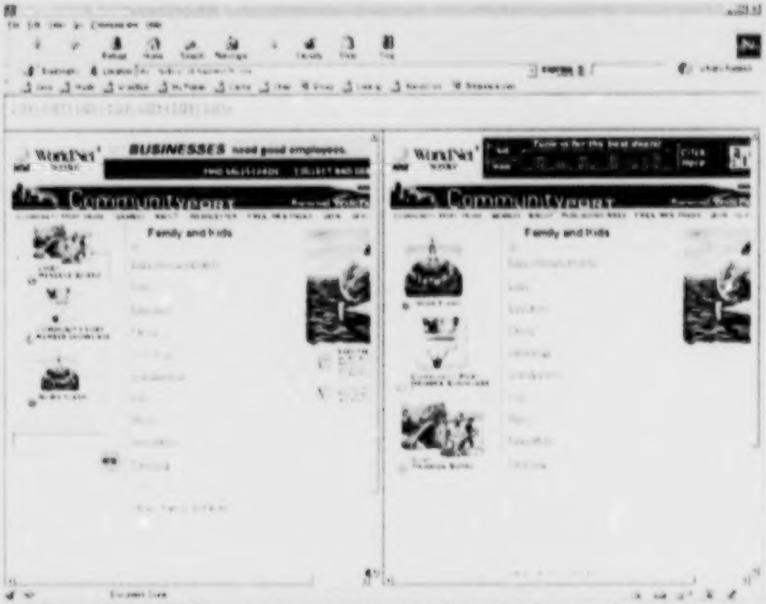

Figure 5: Two-Frame View: Differences between Two Versions of a Page on WorldNet's Community Port

inputs multiple times to improve statistical significance. Instead, we rely on the similarity of comparisons of multiple pairs of versions of the same page and the large number of samples overall. The four benchmarks were as follows:

- *HtmlDiff*. This was the original SML HtmlDiff program.
- *TopBlend*. This was run in "merged" mode, and should produce results virtually identical to HtmlDiff.
- *Vdelta*. This program computes a byte-wise comparison of the two files based on a new fast string algorithm developed by Kiem-Phong Vo. It is not sensitive to HTML markup.
- *Diff -e*. This is the UNIX `diff` program, using the LCS algorithm. It compares on a line-by-line basis.

Using the UNIX `timex` program, we compared the four programs on the basis of execution time (CPU time), mean memory size, and total memory usage (the product of memory size by execution time). We were primarily interested in the differences between HtmlDiff and TopBlend, and used the other two programs as lower bounds against which to compare any possible improvement. Due to space limitations, this paper presents only execution time comparisons; refer to the extended version of this paper (Chen et al. 2000) for additional data.

Execution Speed

We plot (Fig. 6) on a log-log scale the cumulative probability distribution function for each application, where the x-axis represents time and the y-axis represents the fraction of instances in which a given application finished within that time. In general, both `vdelta` and `diff` executed on nearly any input in a fraction of a second. Note that `diff` compares lines while both TopBlend and HtmlDiff perform detailed token comparisons. HtmlDiff executed in under a second on simple inputs but could take minutes on more complicated ones; and TopBlend took about a second on simple inputs (partially due to the start-up time of the Java virtual machine) but ran significantly faster than HtmlDiff on the more complicated ones. The TopBlend and HtmlDiff lines cross at about the 1.7-seconds point; i.e., a greater fraction of HtmlDiff executions took more than 1.7 seconds than did TopBlend executions. Furthermore, while 98.8% of TopBlend executions finished within 1 minute, only 96.7% of HtmlDiff executions did, while the 99th percentile for HtmlDiff was nearly 7 minutes. Since about 99% of the pages can be compared within a minute by TopBlend, the program can be used for on-the-fly comparisons.

Conclusions

As information explosion occurs on the web, the need to digest information quickly will increase. The web age differencing technology offered by TopBlend provides relief by helping web users to identify new or changed

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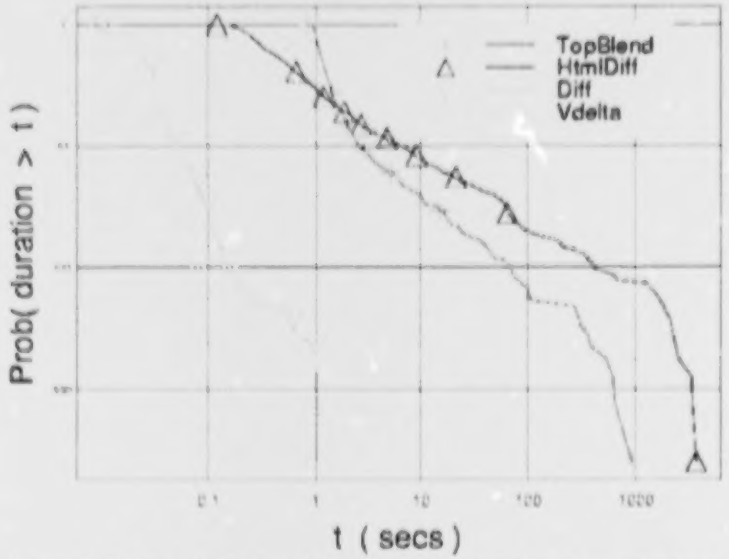

Figure 6: The Cumulative Probability Distribution Function of execution times

web content on their favorite websites. By adopting a fast algorithm, TopBlend significantly outperforms the old HtmlDiff in the most time-consuming jobs and finishes most typical jobs in a few seconds. Furthermore, by migrating to Java, TopBlend allows processing to be performed on increasingly powerful clients rather than on a busy server. For websites with complex graphics designs, the new two-frame view offered by TopBlend avoids clutter by highlighting differences using a side-by-side comparison.

Acknowledgments

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Collaborative Concept Mapping Processes Mediated by Computer

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Abstract: This paper is a report on a study, which investigated group learning processes in computer supported collaborative concept mapping. Thirty 5th grade Taiwanese students were selected to attend a computer mediated collaborative concept mapping activity. According to the analysis of the students' discourse record and group concept maps, it was found that the students took different approaches to develop their group concept maps. In addition, different collaborative mapping approaches generated different concept maps. The findings suggest that students in a computer mediated collaborative concept mapping activity should be guided or instructed to undertake some particular approach to generate satisfactory maps.

Background

Concept mapping is a technique for representing knowledge in network graphs. Knowledge graphs consist of nodes and links. Nodes represent concepts and links represent the relationships between concepts (Novak & Gowin, 1984). Through the construction of a concept map (the integration of new related concepts, establishment of new links, or re-arrangement of existing concepts and links) learning can be assisted. In a meta-analysis of 19 quantitative studies, Horton, McConney, Gallo, Woods, Senn, & Hamelin (1993) reported that concept mapping generally had a positive effect on both knowledge attainment and attitude. Traditionally, concept mapping was carried out using paper and pencil. With that approach, two problems usually are encountered. First, students often need to spend significant amounts of time and effort revising and maintaining concept maps, with the result that many students may not concentrate on the body of knowledge. Second, teachers must spend considerable time and effort evaluating each student's concept map. These problems cause the overall concept mapping effect to suffer. The personal computer is now being used to support concept mapping and several supporting systems have been developed (Fisher, 1990; Kozma, 1987; Kozma & Van Roekel, 1986). It is generally agreed that assisted by computers, students can more easily construct, modify, or maintain their concept maps, and teachers can more efficiently evaluate students' concept maps (Reader & Hammond, 1994).

Concept mapping is usually integrated into cooperative learning activities. Participants are arranged into 3~5 person groups, and collaboratively construct their group concept maps. Although few studies have investigated the effects of collaborative concept mapping, most of the studies have found that collaborative concept mapping can lead to effective discussions concerning concepts, and thus enhance meaningful learning (Okebukola & Jegede, 1989; Roth & Roychoudhury, 1994). With the advancement of network technology, computers can also be used to support collaborative concept mapping just as computers support individual concept mapping. Interconnected computers, digital networks, and the World Wide Web (WWW) make collaborative concept mapping feasible even though the attendants are distributed (Chung, O'Neil, Herl, & Dennis, 1997).

Although the implementation of computers to support collaborative concept mapping has been experimental thus far, it is foreseeable that this application will gradually become practical and even widespread. This is evident by the fact that some organizations have made investments into the research and development of such computer systems. Therefore, it is necessary to investigate learning using computer mediated collaborative concept mapping. This approach may be very innovative from learning in traditional collaborative or computer aided individual concept mapping. In order to examine this the issues of this subject in depth, this study investigated the processes and patterns of students collaboratively developing concept maps in a networked environment. What processes they used to accomplish the concept mapping tasks and how these processes influenced their mapping outcomes were examined. This study not only provides a better understanding of the essentials of computer mediated collaborative concept mapping, but also provides directions for the design and improvement of this activity and its supporting network system.

Methodology

In order to determine what processes characterize computer mediated collaborative concept mapping and how the processes influence the group map production, this study first modified a computer system we developed earlier (Chiu, Huang, & Chang, 2000) to support collaborative concept mapping. Second, primary students were selected to participate in a computer mediated collaborative concept mapping activity.

Subjects

Thirty 5th grade students in Taiwan attended this study. They had one-year of formal education in computer basics and applications. They were able to use a simple word processor, a painter, and an Internet browser. Before this activity, students were provided training to experience paper-and-pencil based concept mapping both individually and collaboratively.

Computer Supported Collaborative Concept Mapping System

The computer supported collaborative concept mapping system was implemented on the WWW platform. Group participants, even though distributed at different sites, could make use of this system to jointly construct their concept maps by connecting to the Internet and using a web browser (such as Internet Explorer). This system included three main modules. Figure 1 presents its architecture.

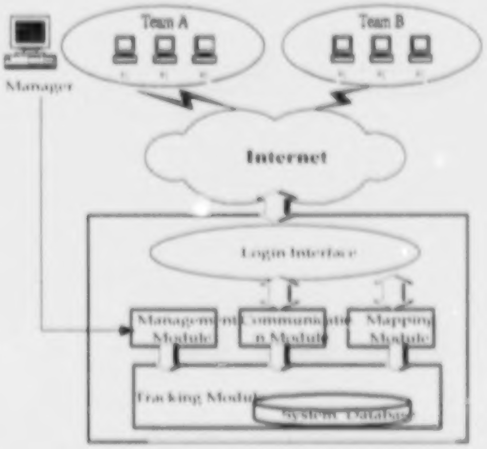

Figure 1: Shows architecture of computer supported collaborative concept mapping system.

Mapping Module

This module provided each group with functions to construct, modify, and reconstruct a concept map. Group members could view the same map on their individual computer screens. However, to avoid possible chaos in the group and concurrent problems in the system due to member cooperation, the mapping control was given to one member. Further, according to suggestions by Chung et al. (1997), this control was fixed to one member and not rotated. The mapping controller could add or delete a concept node and a relation link to the concept map via menu selections or move a concept node or a relation link by towing a mouse around. Once changes occurred, every member's computer screen would be updated.

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Communication Module

This module also provided each group a text-based chat-room. This chat-room was used as a synchronous communication facility. Group members could type messages on individual computers to discuss and reason about their group concept map and then make decisions for any changes. Considering the slow typing problem which normally occurs among primary students, this system further designed quick-input mechanics for those frequently occurring messages (12 messaged were included during this study) in collaborative concept mapping. This system allowed students to make up a message by simply clicking on the appropriate predetermined message (with maybe a little added typing).

Tracking Module

This module could trace the entire process in computer mediated collaborative concept mapping, including dialogue (communication messages) among group members and map products by each group. The system stored these data in its database.

Procedure

The procedure was as follows:

(1) *Grouping.* This study organized subjects into groups of three members. Ten groups were formed. Each group elected a leader to have mapping control. Non-leader members could advise by sending messages.

(2) *Previous Training.* Before starting the formal activity, the subjects received 20-minutes of training on using the system described above. This training included the operations in mapping concepts and synchronously communicating with one another. This training activity arranged the subjects in groups to construct a map with three concept terms (such as "*cerebrum*") and two link terms (such as "*include*").

(3) *Formal Activity.* The subjects were provided 50 minutes to work on their group concept-mapping task. They were told to come to an agreement over any change in their map. This mapping task related to "Computer Hardware." 12 concept terms (such as "*storage equipment*") and 3 link terms (such as "*include*") predefined by primary computer teachers were provided.

Analysis of Computer Mediated Collaborative Concept Mapping

Dialogue messages and map products tracked and recorded by the mapping system were analyzed. The analysis was qualitative in nature. First, dialogue data was examined to categorize the salient features accompanying computer mediated collaborative concept mapping. Further analysis was carried out to realize the structure of the students' concept mapping process. Finally, map data were combined to realize the potential of various collaborative concept mapping processes to improve students' learning.

Findings

Overview of Computer Mediated Collaborative Concept Mapping Process

The basic unit of dialogue is an exchange, which is the set of utterances that serve to achieve some particular mapping purpose. Hence determining the purpose of conversation is an important contribution to classifying an exchange. The exchanges in the dialogue data were divided into four groups. They are:

(1) *Opening a discussion.* At the beginning or to break the silence during developing a concept map, a group member usually opened up a discussion by inviting a more specific discussion of meaning from other members. Normally it was expressed in the form of a question, such as "what shall we do next?" or an invitation, such as "say something, please."

(2) *Introducing a concept.* A group member would introduce a new specific concept to be discussed. After other members' approval (but no proposition content discussion), the mapping controller then selected the concept

from the predefined concept terms. Members would introduce a new concept using a statement, such as "I suggest that we select the *computer hardware* first," or a question, such as "how about *input equipment* "

(3) *Establishing a Link.* Group members would determine the next link in the concept map in developed form. They would make an utterance to clarify the meaning of a concept pair, propose a link, challenge the proposition, and then would either be in agreement on approving the link or move on to investigate another concept pair. Since only the leader in a group could manipulate the map, the leader might initiate a link without common understanding. Members would raise doubts for discussion.

(4) *Reconsidering the map.* Group members would review their concept map in developed form in terms of the relationships among the concepts, the proposition contents, and the concept hierarchy. If any modification was thought necessary, members (particularly non-leaders, who had no map control) would make a request.

It was found that groups in networked environment repeatedly undertook steps of opening a discussion, introducing a concept, establishing a link, and reconsidering the map to collaboratively developing their concept maps.

Patterns of Computer Mediated Collaborative Concept Mapping Processes

The above analysis indicates that opening a discussion, introducing a concept, establishing a link, and reconsidering the map composed the computer mediated collaborative concept mapping process. However, the processes used by different groups varied. Four patterns were found in this study, described as follows:

(1) *Concept introduction first.* Some groups would first introduce and select most or all of the possible concepts related to the theme for discussion among members. They would then establish the links and reconsider their under-developed map later. This mapping process is shown as (a) in Figure 2.

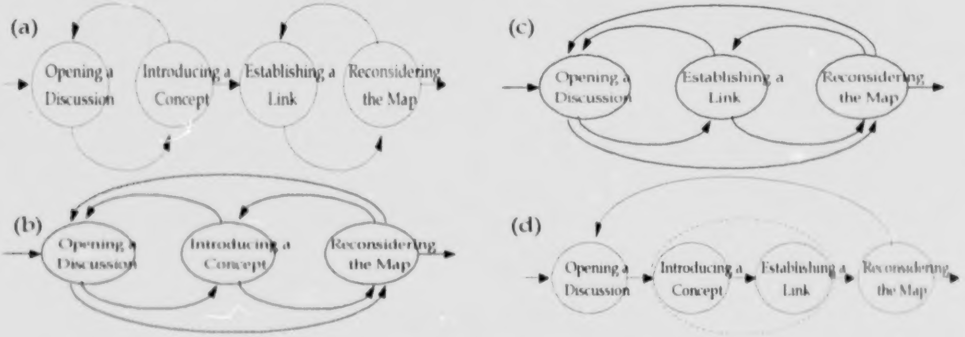

Figure 2: Shows the patterns of computer mediated collaborative concept mapping processes.

(2) *Limited concept introduction.* Group members put more emphasis upon opening discussion, establishing a link, and reconsidering the developed map, but neglected to bring out more new concepts for discussion. Therefore, group members could only focus their discussion on these limited concepts. This mapping process is shown as (b) in Figure 2.

(3) *Less link establishment.* Group members primarily paid attention to the opening discussion, introducing new concepts, and perhaps reconsidering the developed map. Concept elaboration and link establishment were often omitted. Some members might introduce an idea, however others in the group would react by ignoring it, evading it, or recognizing it but moving on. Figure 2 (c) shows this mapping process.

(4) *Proposition construction oriented.* Some groups emphasized proposition construction. A member would directly suggest a term pair, which was thought related or meaningful although vague. Members would then support, explicate, or extend that original idea to generate an approved proposition. While adding a new proposition, members might propose and adjust the organization of the developed map. The process was continued until the group completed its concept map. This mapping process is shown as (d) in Figure 2.

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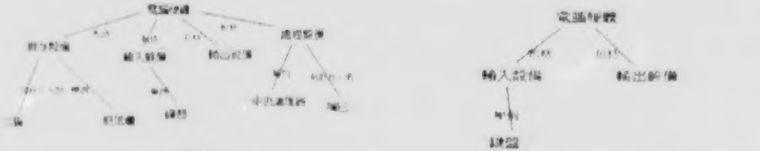
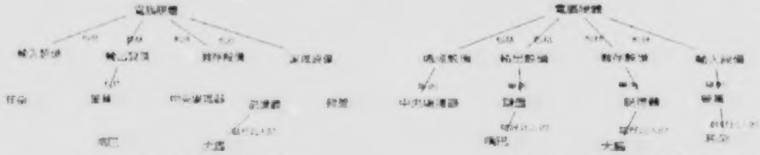
Outcomes from Computer Mediated Collaborative Concept Mapping Processes

Evidence of the outcome of various mapping processes could be provided by the related concept maps in terms of their content and structure and revealed by the scores computed according to a scoring scheme modified from Novak and Gowin's (1984).

(1) *Concept introduction first.* Four groups (G1, G4, G6, and G9) in this study took concept introduction first processes to construct their concept maps. Figure 3 (a) presents a map example produced by these four groups. The average score for these maps was 8.50 (out of 13.00) in terms of proposition, 16.25 (out of 20) in terms of hierarchy, and 24.75 (out of 33.00) in total.


(a) G6 Concept Map

(b) G5 Concept Map


(c) G3 Concept Map

(d) G10 Concept Map

Figure 3: Shows the map examples from various computer mediated collaborative concept mapping processes.

(2) *Limited concept introduction.* One group (G5) in this study took a limited concept introduction process. Figure 3 (b) shows their map. Only a few concepts and propositions were included. This hindered a wider range of discussion. Although the map developed is valid and hierarchical, its score was low, 3.00 on proposition, 8.75 on hierarchy, and 11.75 in total.

(3) *Less link establishment.* Two groups (G2 and G3) in this study used fewer link establishment processes to develop their group concept maps. Many ideas might be raised, but were not discussed further, like their potential relationships. Figure 3 (c) shows an example of their outcomes. Many unconnected concept terms characterized such maps. The average score was 5.50 on proposition, 11.88 on hierarchy, and 17.38 in total.

(4) *Proposition construction oriented.* Three groups (G7, G8, and G10) in this study adopted proposition construction oriented processes to develop their concept maps. Figure 3 (d) shows an example of the generated maps. These maps are satisfying in terms of proposition, validity, and hierarchy. The average score was 10.67 on proposition, 19.44 on hierarchy, and 30.11 in total.

Among the group concept maps produced from the above four mapping processes, maps by the first and forth processes were relatively good in terms of map content and structure. The forth was best, and the second was worst.

Discussion and Conclusion

This study discovered that the process for a group in a networked environment to collaboratively develop a concept map consisted of four main steps: opening discussion, introducing a concept, establishing a link, and reconsidering the map. These steps are similar to those found in paper-and-pencil collaborative concept mapping (Carla, Jos, & Gellof, 1997; Sizmur & Osborne, 1997). In individual concept mapping, regardless if paper-and-pencil or computer based, the reconsideration step was left out. Reader and Hammond (1994) in studying individual computer based concept mapping established this problem, and suggested that automatic feedback be designed into the system to stimulate reflection.

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Although computer mediated collaborative concept mapping processes are composed of the same steps, the processes undertook in fact varied in pattern. Students may introduce many concepts, then gradually establish propositions to complete the maps. Student may focus on only a few concepts and find not much to discuss, and thus generate far from complete maps. Some students may introduce many concepts, but neglect to elaborate on their meaning and relationship, and cause the maps to be characterized by independent concept terms. Some students may introduce one or two concepts meaningful to them to generate their first proposition, then progressively expand the maps. In this study, such maps were superior. These findings not only provide an insight into how different process patterns contributed to students' concept maps and their understanding, but are also meaningful as to the design of computer mediated collaborative concept mapping activities and the supporting network system.

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The Strategic Information Audit as a Front-end to the Development of a Large-scale Web Accessible Information System

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Abstract: This paper reports on the on-going development associated with the U.S. Department of Agriculture's effort to build a comprehensive, high performance, web-based knowledge system know as the Research, Education and Economics Information Systems (REEIS). The paper specifically documents the process, known as the Strategic Information Audit, which was used in the REEIS planning process.

Background

The development and accelerated adoption of new and yet emerging technologies has significantly influenced the direction of agriculture research, education and economics. These changes are significantly affecting the U.S. Department of Agriculture (USDA) Research, Education and Economics (REE) programs and its direction. As the "catalyst and premier provider of knowledge" in all of these areas it is expected that the agencies conducting the programs make use of state-of-the-art technology to strengthen their capacity to conduct research and provide services in a timely, cost-effective manner, while at the same time remaining responsive to issues of accountability and sustainability

- What is needed, from both a management and user's perspective, is an integrated system that provides user friendly and coherent access to a knowledge base of information on the thousands of programs and projects sponsored by the USDA in the areas of food, agriculture, natural resources, and rural development. Unfortunately, the current environment is characterized by: widely dispersed information resources of varying quality and unfamiliar interfaces; information in disparate formats, sometimes incompatible with the tools at hand; a results set from multiple sources that need to be integrated but without the tools to do it effectively; a plethora of tools in the marketplace but limited availability of tools to the user for easily accessing information

Recognizing these developments, there was the authorization for the development of an information technology system to monitor and evaluate the research and extension programs. The Cooperative State Research, Education and Extension Service (CSREES) was designated to organize and coordinate the efforts in the planning and implementation of what has become known as the Research, Education and Economics Information System (REEIS). A multi-phased project, the Strategic Information audit, as describe by Cortez and Kazlauskas (1996, 2000), Cortez, (1999) was initiated. The concept behind the audit is that for organizational management activities to be conscious, deliberate, and collaborative, they must be supported by an effective information infrastructure with rationale and protocols. This infrastructure must be based on well-conceived policies that govern the creation, collection analysis, flow, use storage and retirement of information. The audit provides for the collection of data concerning the efficiency, credibility, and economy of the organization's information handling activities and practices; the provision of adequate policies which oversee these activities and practices; and recommendations for action tailored to the specific organization. It was believed that this approach would be most beneficial as a process to assist in the analysis, planning, and implementation of REEIS. This effort consisted of the following phases: inventory; needs assessment; requirements generation; systems design and implementation; quality assurance; and training.

The Inventory and Web-Based Catalog

The initial step to implementation focused primarily on an inventory of candidate databases that will most probably be part of REEIS. Included in this inventory were legacy databases and web-based systems; small databases as well as very large databases numbering in the hundreds of thousands of records; and textual, numeric, and bibliographic examples. Part of the concept of the audit was to create a sustainable product. Thus, a web-based version of the inventory was developed, the REEIS Database Catalog (RDC). The purpose of this was to serve as a dynamic updateable, descriptive, and interactive, web-based tool for searching and locating information about databases maintained by REE mission agencies. The RDC also provides a link to the actual databases if available on the Internet, and serves as a foundation for the ongoing development efforts.

The Needs Assessment

With the completion of the inventory phase, the plan called for the design and implementation of a full-scale needs assessment study, which was built on the data and analysis of the previous phase. The complexity of the REEIS initiative coupled with the need to retain accountability and maximize resources requires that the project be planned and implemented carefully and systematically. A proven methodology for such a process is the needs assessment. In defining the needs assessment, a discrepancy formula can be applied which is the documented difference between what is actual and what is targeted. This difference is what defines the need. In the context of the current project the inventory phase of the strategic information audit partially describes the actual state, and what is targeted defines the scope and goals of REEIS. The needs assessment study completed the description of the actual state and then investigated and measured the discrepancy between the actual and targeted states, so as to define needs.

The needs assessment consisted of three phases: identification, documentation, and description. During the identification phase, individuals who were involved in, or affected by, the decision-making process were identified and their concerns or goals enumerated. The inventory phase of the information audit provided initial data for the identification phase of the needs assessment, including discussions with a number of users. But additional data are required from administrators and those external users identified in the audit phase. It is also important to gather data from administrators within REE as well as from those in extension who can provide information about the need. In addition, the database administrators identified representative users of their databases. Members of these groups should be encouraged to state their concerns and goals in specific statements of "what is needed." The entire process also provides a vehicle for making visible the attitudes, opinions, and misconceptions of these individuals and groups toward the area under investigation.

In the documentation phase, the wide array of methodologies were employed to gather and document data from a variety of sources. It was concluded that the wide diversity of databases, users and use patterns is sufficient to warrant triangular methodological approaches, whereby multiple sources of data are used to cross-check the validity of information, with a balance between qualitative and quantitative measures. The strategy was to use qualitative tools to determine the perspective of stakeholders and to uncover descriptions of contexts. This should enable us to answer such questions as, "What information do you need to do your job and improve performance?" or "What information is not being provided—or not in the most timely and useful manner—to those who need to access it?"

As part of the REEIS needs assessment, a series of eight focus group interviews, in conjunction with numerous individual interviews, were conducted. The interviews represent a broad constituency of key internal and external stakeholders, including university partners, and staff and administration. The purpose of these interviews was to develop a picture of current information seeking patterns and to elicit in-depth information on the potential uses for and desired elements of REEIS. In addition, a quantitative approach, using survey instruments, was used to solicit input from specific groups. These were groups of individuals who could help craft the REEIS system requirements through their responses to the survey. These survey participants included: USDA Management (USDA managers & National Program Leaders); University administration/management (Deans of Agriculture/Forestry/Veterinary Medicine/Human Sciences & Closely Allied Disciplines; Academic Vice Presidents); Department Chairs of Agriculture/Forestry/Veterinary Medicine/Human Sciences & Closely Allied Disciplines; and University faculty/staff (Teaching Faculty; Research Scientists; Extension Personnel.

In the description phase, the discrepancies between what is and what is needed were generated. These statements about the differences are the outcome of the needs assessment. The result was a list of REEIS Goals and Requirements along with statements about the perceived status and priority of alternative activities. Direction for subsequent decisions and actions are then derived from the type and magnitude of differences and perceived degree of importance of each need.

Generated Requirements

The requirements for REEIS were generated along the five categories as follows.

Environment of the System

It is anticipated that REEIS will co-exist in an open and shared environment. While the use and users of REEIS will define the boundaries of this environment, it will be a fluid environment capable of expanding, retracting, and remaining permeable in order to ensure that REEIS develops and evolves into a dynamic, effective and complete program. Thus, REEIS development and implementation plans should be in lock step with the emerging information technology program for the USDA and the Federal government in general. Likewise the information management policies and procedures that accompany the building of REEIS must be receptive to public demands for access to reliable information, legislative mandates, budgetary and regulatory constraints, and cognizant of the vision for a modernized information technology infrastructure throughout government.

Data Resources

Users locate and retrieved needed information from a diverse and vast number of data repositories that are to be part of REEIS. Still there is insufficient knowledge of the full range of information sources that might be tapped for satisfying information needs. There is also a lack of understanding of the cost-benefits of using one source or format of information versus another, including the use of non-recorded sources of information, such as that which may come through a consultation with an individual. Given the array of decisions, choices and resources, information access is a major challenge for REEIS.

Design

The development of REEIS should be user-centered in all its conceptualization including design, development and implementation. REEIS will need to accommodate users at a variety of levels, and be responsive to multi-dimensional situations and types of queries, and should be designed, as much as possible, to facilitate natural language dialog. In addition, the user interface should be easy to learn, yet sufficiently powerful to support sophisticated information searching and data manipulation. It should also be designed to mirror web technology and access.

Implementation

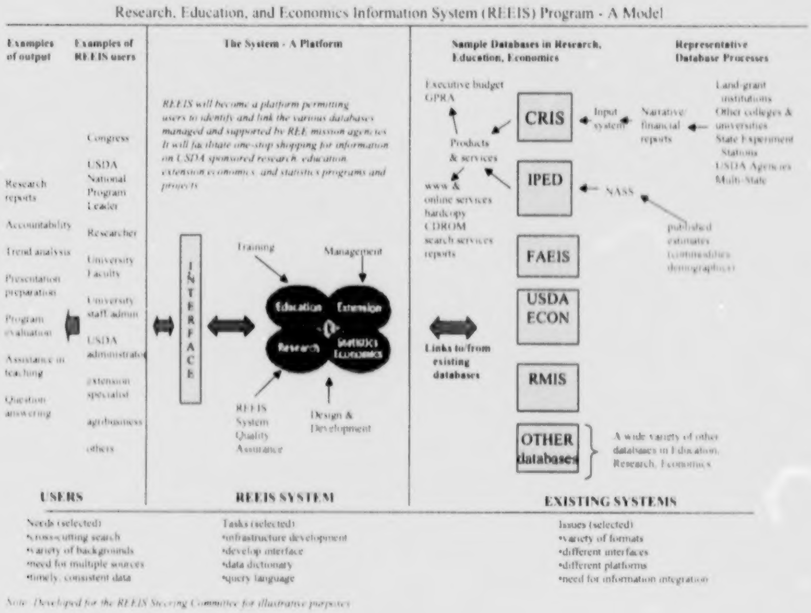
REEIS should be implemented quickly and incrementally, and while in development and operation, be monitored and evaluated continuously in order to assess the degree to which it is achieving it goals. Part of REEIS implementation must include a systematic training program that includes modules and alternative delivery mechanisms in order to accommodate a variety of users, who function at a variety of levels and have different training needs. Implementation also should include a public relations component, and adhere to industry wide standards for hardware, software, and networking.

Management

Once in operation, REEIS should be available 'round-the-clock', and be marketed continuously to new groups of users, particularly to new congressional staff. Evaluation benchmarks should be established for the ongoing quality assessment of REEIS, including the development of metrics to judge the "REEIS readiness" of incoming databases. These same metrics will be used to review the "core" databases in order to determine if they are still within the parameters of REEIS, and to enhance those databases considered critical to REEIS. The REEIS infrastructure needs to be complete and expansive, requiring the consideration of any agency reorganization, and/or expansion. Such consideration should be driven by the need to use REEIS to improve and streamline information management activity throughout REE.

Conceptual Model

A single-page conceptual model of the REEIS system has been developed, see [Table 1]. This model presents the following components: representative database processes; examples of the various databases in research, education and economics that are part of REEIS; the proposed linking system platform illustrating elements of design and development, management, quality assurance, and training; examples of users; and examples of output.


Research, Education, and Economics Information System (REEIS) Program - A Model
Examples of output
Examples of REEIS users
The System - A Platform
Sample Databases in Research, Education, Economics
Representative Database Processes
Research reports
Accountability
Trend analysis
Presentation preparation
Program evaluation
Assistance in teaching
Question answering
Congress
USDA National Program Leader
Researcher
University Faculty
University staff admin
USDA administrator
extension specialist
agribusiness
others
INTERFACE
Training
Management
Education
Extension
Research
Statistics Economics
REEIS System Quality Assurance
Design & Development
Executive budget GPRA
Products & services
www & online services hardcopy CDROM search services reports
Links to/from existing databases
CRIS
IPED
FAEIS
USDA ECON
RMIS
OTHER databases
Input system
Narrative/ financial reports
NASS
Land-grant institutions
Other colleges & universities
State Experiment Stations
USDA Agencies
Multi-State
published estimates (commodities demographics)
A wide variety of other databases in Education, Research, Economics
USERS
REEIS SYSTEM
EXISTING SYSTEMS

REEIS will become a platform permitting users to identify and link the various databases managed and supported by REE mission agencies. It will facilitate one-stop shopping for information on USDA sponsored research, education, extension, economics, and statistics programs and projects.

Needs (selected)
- cross-cutting search
- variety of backgrounds
- need for multiple sources
- timely, consistent data

Tasks (selected)
- infrastructure development
- develop interface
- data dictionary
- query language

Issues (selected)
- variety of formats
- different interfaces
- different platforms
- need for information integration

Note: Developed for the REEIS Steering Committee for illustrative purposes

Table 1: REEIS Conceptual Model

Other Phases and the Current Status

At present REEIS is in the final stages of development. A series of data modeling workshops have been held to identify and describe data and data relationships that will populate REEIS. Policy issues relating to system requirements, such as defining the 'readiness' of a database for REEIS, have been identified and means for implementing the policy recommendations are being addressed. One outcome of the REEIS Needs Assessment Study was the identification of a number of requirements which point to the

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desirability for an ongoing systematic appraisal of REEIS' development and implementation for the purpose of monitoring system quality and providing design feedback. With the aid of consultants who were involved in the needs assessment study and requirements specifications, a quality assurance effort is planned that will be in lock step with the incremental design, implementation, and testing of REEIS. Adopting the International Standards Organization's definition of usability, the plan will focus on assessing the extent to which REEIS "can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." The concepts behind the Quality Assurance Plan include the following: the collection and analysis of data on the REEIS "roll-outs" from a broad range of users; the use of multiple indicators, both qualitative and quantitative; and collection, documentation and analysis of such information over time. The plan assumes the gathering of data from a variety of sources, including: comments from the REEIS Development Team, REEIS Steering Committee, USDA personnel, and typical users; and quantitative data from questionnaires and quantified performance data of both 'experts' and typical users.

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Human-Computer Interaction in Educational Multimedia: Then and Now

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Abstract: This paper provides an historical examination of developments from human-computer interaction (HCI) and computer based instruction (CBI) in order to provide insight into present views of computerized instruction. As a case study, this paper focuses upon developments at the University of Hawaii that span the past thirty years and include innovations in distance education, foreign language instruction, computer-managed instruction, and intelligent computer-assisted instruction. Mention is made of current projects under development at the University that take advantage of wireless telecommunication technology.

Introduction

An historical examination of developments from human-computer interaction (HCI) and computer based instruction (CBI) can be valuable in providing insight into how we presently view computerized instruction. Further, it can provide a framework for potentially fruitful cross-fertilization for the two fields. In setting a foundation for this historical retrospective, we first provide definitions and brief descriptions of the two areas. Then we focus upon developments at the University of Hawaii as a case study. The University of Hawaii has emerged as an innovator in developments in these areas, partly due to its geographic isolation (Hawaii is over 2,000 miles from the mainland U.S. and other large continental landmasses); and geographic "fragmentation" (i.e., Hawaii consists of seven major islands). Further, Hawaii is located at the crossroads of the East and West and frequently takes a leading role in educational interactions involving other Pacific island groups, such as Micronesia, and Samoa. All of these factors have provided the impetus for developing computer-based instruction, networking and distance education, which will be described subsequently.

• Human-Computer Interaction and Computer Based Instruction

To provide some basic definitions and background, human-computer interaction (HCI) is a field of computer science concerning the human use of computing systems. HCI researchers perform detailed investigations of the interactions between human performances and tasks involving computers or computing systems. They also investigate individual differences among people using systems and aspects of software environments that may affect those differences. A basic assumption of this type of research is that computer use can be made easier for a greater number of people by knowing more about the interaction processes between people and various software/hardware environments.

Several years before HCI was recognized as a separate field, extensive research was conducted and comprehensive records were collected on how students interacted with computer based instructional material. Computer based instruction (CBI), in this context, refers to instruction facilitated in some way by computers. Instructors use a mixture of control allocations and environments that often are a function of availability and cost of the technology as well as the instructors' computer expertise.

Within computer-based instruction, learning environments can appear very different depending on how the allocation of tasks is distributed between the human and the computer. As a result, computer based instruction can be classified by the amount of instructional responsibility given to the computer. Thus, environments that have minimal computer control usually have adapted the most available or affordable technology to instructional settings. The lessons and the presentation of instructional material are usually selected from what is already available, rather than authored, by the instructors (Malone, Macken, and Suppes, 1978). Although the instructional materials rely on technology, they may use any or all combinations of: (a) traditional lectures and discussion groups, (b) general purpose computer software such as word processors and spread sheets, and (c) computer facilitated lessons and/or chat groups. It is difficult to incorporate spontaneous social situations found in natural learning environments into computerized exercises that are designed for individual viewing. However, since technology is primarily used to facilitate instruction, CBI environments try to support collaborative as well as individual learning environments.

Further, this paper will describe several projects, developed in Hawaii over the past 30 years, that involve the interaction of students with computer based instructional systems. For example, The University of Hawaii (UH) began pioneering HCI using early computers and networks in the early 1970's, when UH launched the ALOHA network (Abramson, 1973). As a result, UH faculty conducted some of the first studies concerning computer enhanced environments. Students from high schools on Oahu and the island of Hawaii were linked via the department of defense ARPA network connections and Teletype machines at each campus. The ARPA network, based on the packet switching technology that was previously introduced in the ALOHA network, enabled UH faculty in the departments of Information and Computer Sciences and Electrical Engineering to conduct research in computer science topics as diverse as multiprocessor computing systems and HCI. For several years, classes at remote sites throughout Hawaii have been connected using computer infrastructure developed to support computer supported cooperative work (CSCW).

Around the same time PEACESAT was established by UH to use excess time on NASA's ATS-1 satellite for educational and community service communication among Pacific Basin user groups (Glazer, 1983). Teachers used synchronous audio sessions over the PEACESAT communications satellite to establish voice communication networks between Hawaii and South Pacific islands. When work on PEACESAT was initiated, comparable means for communicating with groups of students and teachers at distant places scarcely existed. However, even before compatibility existed among voice, video and computer technologies, educators at the University of Hawaii used a technique called Multi-Mode Node (MMN) telecommunication. In MMN telecommunication, humans translated and relayed information between electronically incompatible systems.

Also, prior to the ready availability of home computers and networking systems, UH educators experimented with Computer-Based Educational Telecommunications (CBET). In classroom applications CBET is used as an aid for planning and conducting electronic field trips and for bringing guest speakers electronically into classrooms. UH educators also used CBET to help them locate references, conduct remote interviews and discuss ideas for projects. Through UH these educators also had access to Programmed Logic for Automated Teaching Operations (PLATO); a computer based educational system comprised of a network of about a dozen PLATO mainframe computers on the mainland and in Europe linked through telephone lines. Asynchronous computer conferences using the PLATO computer networks linked these educators and students for exchanges of written messages containing information, news, questions, and responses.

The concept of Electronic Field Trips (EFT) which engaged students not just as technical facilitators but inquiring learners evolved from the MMN experience. One of the first EFT's was the 1981 Water Quality Information

Exchange Project that involved high school marine science students from nations throughout the Pacific investigating the water quality conditions of their local harbors (Southworth and Klemm, 1985). In more elaborate fields trip dozens of students, natural scientists, and other professionals were involved in studies of natural, environmental, historical, and cultural background of a wetland near Honolulu that was threatened by suburban development.

In 1984, a foreign language specialist for the state of Hawaii founded a company called Teleclass International whose function was to help revive the Hawaii's foreign language program. The goal of Teleclass International was to make language learning realistic, practical, immediate and personal through affordable technology such as videophones and speakerphones. They developed a project that involved 50 schools, 30 countries and 15 mainland states to make over 450 videophone contacts. Foreign language students in Hawaii were linked with native speakers of target languages. A Teleclass language maintenance program was established to foster the improvement of nine immigrant languages found in the state of Hawaii. Since the school based management plan was implemented, the Asian Pacific minorities' video telephone conferencing project has worked directly with schools to establish several classes. These include a Cambodian class at the UH laboratory school, a Tagalog / Ilocano class in Waipahu, Korean and Vietnamese classes at Kalani and an electronic bridge between Hawaii and Japan. The infrastructure was there, waiting for affordable tools and a CSCW environment to be developed.

Currently, a web-based project using similar ideas is being conducted in the department of East Asian Languages and Literature at the University of Hawaii using the chat facility on the Internet to link Japanese classes from Connecticut, Hawaii and Japan. A language corpus is being collected for instructors planning the class as well as for the students enacting the planned activities. The transcripts from these sessions will be analyzed and the results will provide valuable information for the instructors as well as for HCI and CSCW researchers (Vick, Crosby, and Ashworth, 1999).

Two other areas of computer-based instruction (CBI) include computer-managed instruction (CMI) and intelligent computer-assisted instruction (CAI). In the sections below, we describe examples of developments in both areas at UH.

• Computer managed instruction

Computer managed instruction (CMI) primarily refers to environments where computers serve as administrators for individualized instructional programs. These systems rely on computers for tasks such as registration, testing and grading. In these systems, the instruction is normally self paced, deficiencies are flagged, and progress is noted. CMI systems that focus on administration can bring together software and hardware to produce cost effective systems. Many of the lessons are conducted using a variety of instructional techniques. One of the advantages of this type of system is that the task of finding the resources and giving the assignments can be automatically performed by the computer, based on an evaluation of the students' progress during the instructional process. Large introductory classes at UH such as Psychology 100 and Information and Computer Sciences 101 use CMI systems. In addition to instructional effectiveness, CMI systems are also often evaluated by the amount of cost savings. If transcript data is saved from student interactions, it rarely provides information about the types of misconceptions held by the student (Hopmeir, 1984; Hofman, Waters, and Berry, 1981).

• Intelligent computer assisted instruction

The most instructional control is found in courseware that incorporates the products and techniques of artificial intelligence (AI) (Burton and Brown, 1979). Educational software has benefited from AI that uses human intelligence as a model and source of data (Merrill, 1987). Intelligent computer assisted instruction (ICAI) has been used in many learning environments with varied degrees of success (Kearsley, 1985). Included in most ICAI systems are the representations of the subject material, the student model, and the instructional strategy. The subject material must be organized in such a way that acquisition and retrieval of the information is efficient. A goal of ICAI is for the computer to automatically be able to infer new knowledge. A student model is derived from the student's behavior. Since the student model is aware of the student's possible misconceptions, the instruction can be adapted to the individual. ICAI systems try to emulate the way a traditional teacher interacts with students, chooses the lessons, evaluates the answers, give answers. Some ICAI systems have combine recent advances in natural language processing and speech recognition to greatly improve the perception of natural dialog in the courseware. Transcript data collected from the student interactions with CAI courseware and ICAI systems provide insight into how to improve future student models (Crosby and Freese, 1990; Crosby and Iding, 1997).

The majority of foreign language learning software belongs to a category called computer-assisted instruction (CAI). CAI is a flexible type of computer based instruction that can be used in simulations and in conjunction with other instructional systems. CAI courseware can include additional instructional materials as well as an authoring system. The focus of CAI courseware is to provide detailed lessons with specific objectives and a means of testing whether the objectives have been met. The computer presents the students with specific instructional tasks either as a course or as a portion of a course. Primarily, this type of instruction focuses on interactions between individual students and the courseware.

UH language teachers were among the first to craft Japanese lessons using Kanji characters on computer systems such as PLATO. Much of the research conducted at the Hypermedia Lab in the Department of Information an Computer Sciences at UH has used simulations to not only develop courseware but to investigate how students' individual differences influence performance (Crosby, Stelovsky, and Ashworth, 1994). This type of research necessitates data collection and its analysis. In controlled experiments this means gathering information about the user and their performance on representative tasks. We found that automatically recording all the students' actions provides valuable information and is unobtrusive. We developed a multimedia support environment to facilitate our experiments, which incorporated experimental design, data collection, and analysis. In particular, our environment helps control the experimental design, manage the experiment and analyzes the data (Stelovsky and Crosby, 1997). Software referred to as the "Observer" can be inserted into programs so that all of the user's actions are recorded, and using artificial intelligence techniques the observer can deduce a pattern of behavior. The problem is that functions of a higher level than mouse clicks and key actions are desired. This environment was tested for a software transcription task (Crosby, Stelovsky, and Ashworth, 1996). Transcription is an example of a task that requires an intensive interaction of the subject with a sound recording. Results from controlled experiments showed that the "Observer" could give predictive information concerning the users' intentions. Findings such as these from HCI studies can be used to develop adaptive user interfaces that are able to adjust learning tasks to the user's level of expertise. HCI research results can also be used on the users' interaction with the software interface to determine specific properties such as an optimal sound quality for a particular task.

Thirty years ago, UH researchers started with primitive tools and with great difficulty were able to use primitive HCI techniques in educational multimedia environments. Currently, researchers at UH are developing a wireless computing environment (Abramson, 1994). For example, a World-Wide-Web based analysis tool has been developed that visualizes data collect from eye-movement monitors in the ICS department at UH. It is now possible to remotely watch, in real time, a subject performing a task and see the coordinates of their eye fixations super-imposed over the scene viewed. This environment has the potential to facilitate the development of better collaborative CSCW tools that help perform more naturalistic evaluations. This facility may be particularly useful for distance education applications. As the teacher will not only be able watch the students perform tasks but they will also be able to monitor their focus of attention. In the future the development and implementation of pervasive ubiquitous computing and virtual environments will facilitate evaluation tasks even further.

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Dinopolis - A Leading Edge Application Framework for the Internet and Intranets

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Abstract

Dinopolis is at the moment the most universal and extendable application framework available. It is fully written in Java and fully compliant to today's application standards like Corba, RMI, DOM and XML. As a middleware system it provides access to arbitrary existing systems and supports combination of external systems in a way that they benefit from each other, although they do not even know about each other. The Dinopolis approach described in this paper makes it very easy to integrate even very proprietary systems and to provide a portal to a distributed, (globally) shared ressource space. Dinopolis is accessible with arbitrary clients (e.g. Netscape, MS-IE) due to the extendable gateway philosophy, not to speak about Corba and RMI accessibility for application programmers. In this paper the motivation for Dinopolis is explained as well as the cornerstones of the design and implementation are briefly discussed.

Keywords: Internet, Intranet, Distributed Object System, Middleware, Application Framework, Java

1 Motivation

Although corporate Intranets, application servers and portal systems have been buzz-words for quite some time now. Although most organizations have some kind of an Intranet structure, it is worth to take a deeper look at today's solutions: what is called a corporate Intranet mostly consists of one or more HTTP servers and a mixture of CGI-scripts and servlets to make some information from other sources available on the Intranet. Access-logic for the different systems is partially hidden behind the scenes and therefore access is easier for the users. Sometimes so-called portal servers are providing a single point of access to several resources of the corporation. Nevertheless, there is usually no combination of different available systems in a sense that they add value to each other.

To make this fact clearer let us consider an organization that runs an SQL server for administrative information like employees' and general project data. In addition, suppose that MS-Project is used for project management. Software developers use CVS and source code documentation is stored in the filesystem. For bugtracking and software support a proprietary software package is used as well as for the shared calendar. If there is any portal system available in the company at all, then it is usually a so-called application server or enterprise server that provides HTTP access to some of the information space. The SQL server is accessible via servlets and the project plans are made accessible if they are inserted into the server by hand. Maybe also the bugtracking- and support-systems are accessible via HTTP and nobody has to care about the access logic for the different systems. Clearly, such a portal is a great advantage compared to having several different systems requiring different software and knowledge to access them. One of the most advanced systems is the Hyperwave Information Portal (short *HIP*, see also [Hyperwave]). However, even such sophisticated portals cannot be seen as the proper long term solution. Several further important aspects have to be taken into account:

- Although systems are accessible through one single portal they are still somehow treated as stand-alone systems. No real *combination* of the systems is achieved because they do not know about each other and therefore they cannot benefit from each other. Combination in this context means that e.g. an information system serving documents without meta-data can be combined with a database serving meta-data. The portal as a result serves documents with meta-data transparently.

- No stable address-space is provided by portals, therefore restructuring the underlying information space is a rather difficult affair.
- No globally unique address space is provided and usually URLs with proprietary parameters interpreted by special CGI scripts or servlets are used for access. Therefore addresses are only valid for one portal, rather than being globally usable.
- Portals themselves can usually not be distributed in a sense that several portals integrate different systems and are combined to provide a transparent distributed resource-space accessible as a unit.
- Usually only systems providing (passive!) information can be accessed through the portal. Active systems supporting mobile agents, communication and collaboration features cannot be fully utilized.

From our point of view an organization's knowledge and information space has to be considered as a huge arbitrarily combineable and easily accessible distributed resource space. Systems embedded in this resource space have to gain value from each other, users should have different ways available to access the whole resource space and applications should easily be able to utilize this resource space for their own purposes. To get back to the example above: wouldn't it be nice to be able to have links between project-management data, employees' data of the programmers and the source code they have written? Additional links between the bugtracking system and the appropriate versions of the source-code combined with the support system would ease software support enormously. If this is then also interlinked with the shared calendar, progress tracking and timetables for future developments are much easier to maintain. Also the shared calendar can be automatically linked e.g. to the organization's email system so that all coordinators are automatically alerted of changes in schedule. Active trigger elements and software agents can ease coordination of huge and complex projects.

Just as a tiny example an agent (see also [Logan, Sloman 1999]) could be sent into the system to coordinate an urgent meeting. This agent then has a look at the calendar of the single persons as well as their scheduled deadlines and priorities. It calculates a meeting date and sends email to all participants. They can then decide to either accept the proposed date or ask the agent to look for a different one.

Today there are several highly sophisticated enterprise- and application-servers existing like e.g. Netscape's application server, Oracle 8i, IBM's WebSphere and NetDynamics by Sun just to mention the most important ones. Also a few distributed object systems like ObjectSpace's Voyager provide some of the functionality required for a distributed resource space. Several middleware libraries for system integration help the developers to gain easy access to external resources.

All of the systems mentioned above have their advantages, but none of them really provides the functionality needed to fulfill the vision of a distributed resource space that is outlined above. What is really needed, is a middleware layer that is able to embed existing systems, allows to combine their features and provides a virtual data- and application model to access them in a uniform way. Please keep in mind that uniform access in this case does not only mean uniform for users like e.g. HTTP portals allow. Uniformity shall also be provided for applications in a sense that they do not have to be aware of the underlying systems at all. Additionally the whole middleware layer has to be open to allow integration of arbitrary systems rather than to support just a few standard ones. Last, but not least, the layer has to be platform independent and open to existing standards like Corba and Java RMI to easily allow standard applications to access it and gain all the benefits.

With these requirements in mind a team of 8 researchers started to design and develop a Java middleware system in 1997 called *Dino* (see also [Freismuth et al. 1997]). Version 3.0 of Dino was successfully used for a medical telematics platform called *MTZ* (see also [Freismuth et al. 1998]), which was presented at CeBit 1999. After that the team decided to use the experiences gathered throughout the years, make a complete redesign, and make the resulting system named *Dinopolis* open source (see also

[Dinopolis Developer Community Home Page]). In the following sections the cornerstones of Dinopolis will be described – cornerstones that make it a unique framework providing functionality not available with any other system up to now!

2 The Dinopolis Distributed Application Framework

From the very beginning four main design principles formed the credo of Dinopolis development:

- Dinopolis is a very modular, extendable and platform-independent system rather than a huge proprietary monolith. The base system providing the information model is very slim.
- Dinopolis allows to integrate and combine arbitrary systems, no matter if they are only dealing with passive content or also with active content as "real" distributed object systems do.
- Dinopolis is an application framework that supports major industry standards. It provides access to the underlying distributed information space in a fully transparent manner for users as well as for applications utilizing it.
- Dinopolis systems can be arbitrarily distributed across the network. Nevertheless all handles used to access objects within the framework are globally unique and stable. Therefore once a handle is obtained, the object that it refers to can be moved to arbitrary locations, even across the network but the handle will still be valid.

To achieve platform independence to the maximum extent possible today, Dinopolis is written in pure Java. Since Java allows classloading on demand this decision also provided the key to make the base system that implements the Dinopolis virtual address- and relation-space very slim. All additional functionality is grouped around this kernel in a modular way without making it a huge monolith by use of factories (see also [Gamma et al. 1995]).

The concept of the virtual address- and relation-space is general enough to be able to integrate basically all systems that allow some kind of addressing of objects. No special requirements for the kind of addressing have to be met for integration. For this reason Dinopolis addressability is supported for all systems known today from simple filesystems to databases or other information systems as well as for distributed object systems. Integration of systems is done by means of so-called *embedders* that provide addressing as well as arbitrary additional functionality of the underlying systems. With this concept the superset of functionality of all systems is available for the applications rather than the subset as in other comparable middleware approaches.

Since Dinopolis is a distributed application framework it has to be useable in different ways. First of all it can simply be taken as a Java library that applications can utilize. On the other hand one of the Dinopolis modules allows it to run a server that supports RMI and Corba for already existing applications that want to benefit from its features without rewriting the application. Last, but not least, the standard distribution also contains external access gateways (=*EXAGs*) to allow access to the information space via HTTP, FTP and Telnet. Other EXAGs like SMB, NFS, etc. will follow in the near future.

Embedders as well as EXAGs are easy to write, therefore third parties can tailor the system according to their needs. Because Dinopolis is open source it can be expected that many different embedders and EXAGs for all commonly used systems will be publicly available soon. An example for a custom embedder would be to integrate a proprietary bookkeeping system that has been around in an organization for ages, thus making it part of the globally shared resource space. Depending on the complexity of the underlying system, embedders are usually very easy to write. Providing addressing for objects in the underlying system is enough to integrate the external system and make it available for Dinopolis. As soon as a system is embedded all the benefits of stable object handles, arbitrary relations and links, special attributes, etc. apply for this system implicitly.

As an example for a custom gateway take somebody wanting to use Dinopolis with a Gopher client. In this case an EXAG for Gopher access can be written within a day (and will very likely be available in the standard distribution soon), because implementation of the slim Gopher protocol is the only work to do. The rest is a simple 1:1 mapping.

Due to the fact that Dinopolis provides access to objects by means of stable handles rather than instable URLs (see also [Andrews et al. 1995]) huge distributed resource spaces can easily be administrated. It is no problem to move objects around in the resource space, the handles are globally unique and stay valid. Beyond moving objects without loosing stability, it is even no problem at all to change the underlying embedded system and still have valid handles! This fact is even more important as the following example shows: Take a small organization that maintains some files for their employees' data. If this organization grows it is very likely that this way of storing data has to be replaced by a powerful database for administrative reasons. Using Dinopolis as a front end to access the data completely decouples the application from the underlying system. This allows to transparently embed the database instead of the filesystem and the handles still remain stable. Applications accessing the Dinopolis resource space do not even notice the change!

Further, highly sophisticated mechanisms of the *Distributed Dinopolis Communication Protocol* (=DDCP) allow transparent replication and mirroring of resources. DDCP itself is a high-level protocol which utilizes RMI or Corba (or if desired also other protocols) as a transport layer.

Handles also need not refer to one single object in an embedded system. Due to the sophisticated embedding and combination mechanisms of Dinopolis, handles can refer to a combination of objects. As an example a simple filesystem can be embedded to store arbitrary chunks of information. Besides an SQL server is embedded to store meta-data for the information chunks and make it searchable. Additionally a directory service like LDAP is embedded to store logical combination-relationships of documents. A handle then can point to one *logical* document that consists of several information chunks and several sets of meta-information as defined in the directory service. Requesting the object for such a handle then transparently returns one single combined content object representing the logical document.

Last, but not least, part of the Dinopolis framework is a highly sophisticated and highly modular security architecture. This architecture supports the use of security models implemented by embedded systems as well as to wrap an arbitrary security model around embedded systems. This allows it to incorporate authorization and authentication mechanisms even for systems that do not support such mechanisms at all. However a detailed discussion about the complex security model would be beyond the scope of this paper.

3 The Dinopolis Addressing, Relation and Content Model

Much has been said about stable addressing and arbitrary relations between objects up to now. Now it is time to discuss the model that is implemented in Dinopolis to make this possible. The most important design point in the Dinopolis system is to completely decouple addressing from relations and content. Addresses in Dinopolis are wrapped by handles and are used to gain access to objects. It is not possible to *navigate* through the address space. That's what relations are good for: relations can be of arbitrary type, they can exist between arbitrary objects and they allow navigation in the resource space. All objects that can be accessed are considered *content* from the computer scientists' point of view and content is always presented in form of DOM trees. Therefore Dinopolis can also be seen as what is widely called an XML system today.

This might not sound great or new, therefore let us have a look at existing systems to see the difference:

As our first example let us take a simple filesystem. In this case the path to a certain file or subdirectory is the address of this object. However it is not only the address! It also implicitly contains parent-children relations that can be used for navigation. Therefore changing the address of a file by moving it around also changes relations. Although this is the semantic behaviour of a filesystem that everybody got used to, it also presents several problems because it is not possible to differentiate between *logical* and *physical* parent-children relationships. Usually subdirectories are used for logical structuring reasons, but if the disk becomes full and data has to be moved to a different location the physical necessity breaks the logical structure.

On a standard WWW server hyperlinks are used to model relationships and therefore the problem mentioned above is hidden behind the scenes. So far, so good, but this just moved the problem a little, because here hyperlinks are physically embedded in documents. Therefore relations and content are mixed up, which makes the situation even more difficult: moving a document physically on a WWW server means to edit all documents with hyperlinks pointing to the moved document.

In Dinopolis handles are used to access objects following the URN principle. Due to internal algorithms the handles remain stable, even if the objects are moved. Relations between objects can be of arbitrary type (e.g. parent-children, hyperlink, etc.) and are kept separated from addresses and content. Therefore relations are also not affected by restructuring or even by a completely different address space due to underlying system changes. Content is considered a logical rather than a physical entity and is always presented in the form of a DOM tree that can be made up of arbitrary many different information chunks. This strict separation makes it possible to have a portal that really *combines* all the data and features of underlying embedded systems.

4 Dinopolis Embedders and External Access Gateways

Now that we discussed the internal Dinopolis addressing, relation and content model, we can move our attention to the last cornerstones of Dinopolis: Embedders and External Access Gateways (short *EXAGs*). Embedders form the lowest layer of the Dinopolis system and are used to provide access to existing systems. EXAGs form the highest layer of Dinopolis and are used to provide access to the system for arbitrary clients.

The task of an embedder is to map the addressing scheme and the relation scheme of an external system to Dinopolis' internal representation as well as to provide objects of the external system as DOM trees. Because of the strict separation of the single elements in Dinopolis this is an easy task as the following example of a filesystem embedder will show:

Files in a filesystem are addressed by paths. Therefore a path to a file is handed over to the Dinopolis system as a so-called Dinopolis Object Handle (short *DOH*). Please note that this handle is different from the internal stable handles. Implicit parent-children relations in the filesystem used for navigation are handed over to Dinopolis in form of Relation Objects (short *RO*s). Finally files are wrapped into Dinopolis Content Objects, which are represented by DOM trees. Factories are provided for content handlers that can deal with different types of data, therefore the embedder need not care about the DOM model itself.

It can easily be seen that these simple requirements concerning addresses, relations and content can be fulfilled for more or less all different kinds of systems very easily. Therefore embedders for different systems are light-weight and can be implemented quickly.

The task of an EXAG is to implement the server part of the desired access protocol (e.g. HTTP, FTP, etc.) and to provide the client with the desired data. Usually the only task to perform for an EXAG, as far as Dinopolis is concerned, is to map the requests to handles and return the requested objects to the client in a reasonable format. The Complexity of an EXAG is therefore defined by the requirements of the external access protocol and will in most cases more or less be a 1:1 mapping to Dinopolis' addressing, relation and content model.

5 Conclusion

Although a lot of the design decisions and algorithms could not be explained in depth in this paper, we hope that it became clear that Dinopolis is an application framework with functionality not available anywhere else. It is easily extendable by embedding new systems and combining them with others. Access is always performed by stable, globally unique handles. Dinopolis is easily accessible with arbitrary clients by providing different EXAGs. Finally it is fully compliant to today's distributed object standards like Corba or RMI and using DOM/XML as the internal content model makes it easy to deal with all different kinds of resources.

Therefore it does not only have functionality not available anywhere else, it also has accessibility and extendability that goes far beyond other available systems. Since it is also fully written in Java it is as platform-independent and universal as today's techniques allow.

As a last plus-point let us again mention that Dinopolis is open source and available free of charge for everybody wanting to benefit from its features.

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Making General-Purpose Adaptive Hypermedia Work

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Abstract: Adaptive hypermedia systems (AHS) have typically been geared towards one specific application or application area, in most cases related to education. The AHA (Adaptive Hypermedia Architecture) system is a Web-based adaptive hypermedia system specifically intended to serve many different purposes. As such AHA must be able to perform adaptation that is based on the user's browsing actions, regardless of the interpretation of browsing as learning. A general-purpose adaptive hypermedia system must be able to handle *cycles* in adaptation rules and *non monotonic* user model updates. (An educational system in which a user's knowledge about a hierarchical concept structure can only increase is much simpler.) This paper describes how AHA handles these aspects and indicates how other adaptive hypermedia systems may be turned into more general-purpose tools as well.

1. Introduction and Background

Authoring usable hypermedia documents is difficult. On the one hand an author wants to offer a lot of navigational freedom, with short paths to every possible destination. But on the other hand an author wants to avoid overloading the user with too many links, which would make the selection of appropriate destinations difficult. Many adaptive hypermedia systems (AHS) (Brusilovsky 1996) tackle this problem by automatically selecting or emphasizing those links that are considered "appropriate", based on a model of the user's state of mind.

AHS store some features of the user, often called *preferences* (which are set by the user and not altered by the system) and *knowledge about concepts*, in a *user model*. That model is maintained and updated while the user is browsing. Relationships between pages or *concepts* are simple: many systems only deal with *prerequisite relationships*, meaning that one (prerequisite) concept should be studied before another one. These types of systems are well suited for educational applications that share the following properties:

1. Once the conditions (prerequisites) for a concept are fulfilled they remain fulfilled. (When the user is ready to study a concept, she will always remain ready to study that concept.)
2. A user's knowledge about a concept can only increase. (The user never forgets what she has learnt. A possible exception is when a student performs badly on a test.)

Educational AHS are based on the notion that the user model consists of *concepts* with an associated *knowledge value*. Each time a page (about a concept) is accessed some server-side program (e.g. a Java Servlet) registers this access and updates the knowledge value for the associated concept. To turn such a system into a general-purpose one the notion of *knowledge about a concept* must be generalized to *value for a user model attribute*. As such a concept need not represent domain knowledge, and the attribute may represent any kind of property. As such, the applications an AHS must deal with may not satisfy the two properties above.

In (De Bra & Calvi 1998) we presented a first version of the AHA system, which allows applications to "violate" the first property: the condition for including or providing access to a piece of information may include negations. Thus, still in educational terminology, learning about a concept may make another concept superfluous and therefore hidden or inaccessible. We call such relationship an *inhibitor*. In the first version of AHA applications must still satisfy the second property. This paper presents the next version of AHA, which supports applications that do not satisfy the second property. In addition, knowledge is no longer represented by a Boolean value (*known* or *not known*) but by an integer value between 0 and 100. We give some interesting examples of "general purpose" use of adaptation rules that show adaptive behavior that is very different from that of applications for learning.

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The design and development of the general purpose AHA system posed some interesting challenges. In order to accommodate a rich model of an application domain we allow the definition of *concept relationships*. Changes to the (user model) value for one concept may induce changes to (the value of) other concepts. Updates to the (knowledge) value for (small) concepts can contribute towards the (knowledge) value for another "higher level" concept. In AHA values can be updated arbitrarily (increased and decreased). Decreasing values is probably most useful in applications where the values have a meaning other than "knowledge". Also, the structure of concept relationships is not required to satisfy constraints such as being acyclic. (A concept knowledge hierarchy would normally be acyclic.) In general, allowing recursive updates to the user model may:

1. generate unpredictable or even undesired results;
2. cause infinite loops of updates.

This paper describes how AHA deals with recursive adaptation rules in order to guarantee that the outcome of each user model update is always predictable and desirable. We illustrate this with some typical examples of update rules.

This paper is structured as follows. Section 2 briefly describes the architecture of AHA. Section 3 illustrates why AHA has a *recursive* update algorithm. Section 4 describes the user model update algorithm, and shows the deterministic (and finite) behavior of that algorithm. Section 5 gives a few non-educational examples expressed in AHA. Section 6 concludes with remarks on possible future extensions of AHA.

2. Brief Overview of AHA

The general structure of AHA is somewhat comparable to many other AHS, as described in (Brusilovsky 1996). In (De Bra, Houben & Wu 1999) we defined a reference architecture for AHS, called AHAM. According to AHAM an adaptive hypermedia application consists of three parts: a *domain model*, *user model* and *adaptation model* (previously called *teaching model*). In the (new) AHA system these three parts have the following structure:

The *domain model* describes the application domain in terms of *fragments*, *pages* and (abstract) *concepts*. Each page is an XML file with (almost opaque) fragments that are conditionally included, and with hypertext links. In our current applications the "opaque" content is actually HTML, but AHA simply ignores this content except for the links. In the sequel we use the term *page concept* to indicate a concept represented by a page. When we just say *abstract concept* we mean a concept that is not a page. The term *concept* is used to indicate a concept that can be a page concept or abstract concept. AHA distinguishes three types of *concept relationships*:

- **link** relationships: AHA recognizes HTML anchor (A) tags that represent hypertext links between page concepts. (AHA only uses links between pages, not between abstract concepts.)
- **generate** relationships: In AHA the access to a page may (recursively) cause an update to several elements in the user model. The *generate* relationships specify these updates. They are stored (together) in a special XML file. (See the *adaptation model* below.)
- **requirement** relationships: In AHA fragments, pages and concepts may be considered *desirable* or *undesirable*. The *requirement* relationships specify the conditions for this "desirability". The *requirement* relationships for fragments are stored inside the pages; the requirements for pages and abstract concepts are stored in a special XML file. (See the *adaptation model* below.)

The *user model* consists of some user identification and preferences, and then for each (page or abstract) concept in the *domain model* a (knowledge) value. This information is stored in a special XML file. All values in AHA are integers between 0 and 100, just like in Da Silva's educational system (Pilar da Silva 1998). AHA also keeps a logfile (per user) with all page accesses. Note that knowledge about fragments is not represented in the user model.

The *adaptation model* consists of author-defined *generate rules* (each corresponding to a set of *generate relationships*) and *requirement rules* (corresponding to *requirement relationships*), and some system-defined *adaptation rules* that define the adaptive behavior of AHA. The basic adaptation rule of AHA deals with the "desirability" of fragments, pages and abstract concepts. The *requirement rules* define this desirability. A requirement for a page or concept looks like:

```
<concept>
   <conceptname>theconcept</conceptname>
   <relationexpression>req1 > 30 and req2 < 80</relationexpression>
</concept>
```

This entry (in the XML file containing the requirements) means that the desirability of "theconcept" depends on the value of concept "req1" being higher than 30 and the value of concept "req2" being lower than 80.

For a fragment the following piece of XML is included in a page:

```
<if expr="req1 > 30 and req2 < 80">
    <block>here is the conditionally included fragment</block>
</if>
```

The "visual" result in AHA of requirements being satisfied (or not) is as follows:

- AHA has three link colors, called GOOD, NEUTRAL and BAD. (They are user-defined, and *blue*, *purple* and *black* by default.)
    - When a page is *desirable* (i.e. its requirement is fulfilled) it is shown in the GOOD color if the page was not visited before, and in the NEUTRAL color otherwise.
    - Links to an *undesirable* page are shown in the BAD color.
- When a fragment is *desirable* (i.e. its requirement is fulfilled) the fragment is included in the page.

The link colors are enforced through the use of link classes combined with a style sheet. So although these colors are blue and purple by default, it is AHA that enforces the use of these colors, not the user's browser.

When a page is accessed its value in the user model is updated. Initially the value is 0. When a *desirable* page is accessed its value is increased to 100. When an *undesirable* page is accessed its value is increased to 35 or left at its previous value if that was already 35 or higher. Changes to the value of a page may induce updates to the value of other concepts, based on the *generate rules*. The *generate rules* are stored in an XML file. Entries look like:

```
<genitem>
    <name>concept1</name>
    <genlist>concept2:+40 concept3:-30 concept4:50</genlist>
</genitem>
```

This relationship means that when the value of concept1 is augmented by X (for instance 35, 65 or 100), the value of concept2 is augmented by 40% of X, the value of concept3 is decremented by 30% of X and the value of concept4 is set to 50, independent of X. (The resulting values are "clipped" so they remain between 0 and 100.)

Typically the *generate relationships* (and *rules*) are used to model a hierarchical (containment) structure of concepts and subconcepts. When a section of a textbook contains 5 topics (or pages), each page may *generate* 20% of the knowledge for that section, so that the *value* of that section concept becomes 100 after reading all 5 pages. However, many other uses for *generate clauses* exist. The example above already shows that a page access may cause the value for a concept to decrease as well as increase. This clearly does not fit the model of knowledge in a hierarchy of concepts. We will give more examples later.

Because general-purpose authoring tools for XML data files are currently lacking AHA comes with some scripts to convert HTML pages to the required XML syntax and with a forms-based interface for creating the list of *generate rules* and *requirement rules*.

3. The Need for Recursive Updates

All adaptive features depend heavily on the updates to the user model being performed correctly. In the first version of AHA every access to a page could only change the Boolean value for some concepts. Consequently it was not possible to express that 5 pages contributed towards one "composite" concept. As a result the definition of some requirements like prerequisites was difficult. If some information in a document depended on a chapter of 5 pages having been read completely, the first version of AHA required clauses like:

```
<relationexpression>p1 and p2 and p3 and p4 and p5</relationexpression>
```

In the new AHA one can define each page to generate 20% of a "chapter" (apart from generating 100% of itself). A page for which the entire chapter is prerequisite knowledge then has a requirement:

```
<relationexpression>chapter=100</relationexpression>
```

Apart from this, it becomes possible to require at least 4 out of the 5 pages to have been read by specifying:

```
<relationexpression>chapter>=80</relationexpression>
```

(This would require a very long expression in the old AHA system.)

Pages and concepts can also form a deeper hierarchy, like when pages contribute knowledge to a section and sections to a chapter and chapters to a whole book. In the new AHA such "cascading" knowledge contribution can be *expressed* using recursive rules:

```
<genitem>
   <name>somepage</name>  <genlist>sectionXY:+20</genlist>
```

```
</genitem>

<genitem>
   <name>sectionXYZ</name>  <genlist>chapterX: +25</genlist>
</genitem>
<genitem>
   <name>chapterXY</name>  <genlist>book:+20</genlist>
</genitem>
```

Now, in order for page accesses to contribute towards the (knowledge) value of the whole book, user model updates must also be *performed* recursively by AHA. This is easy to implement, and safe for concept hierarchies (i.e. acyclic structures with only positive contributions to knowledge values). However, when designing the user model update algorithm so that it works with arbitrary *generate rules* the following issues have to be dealt with:

1. There may be loops in the recursion.
   Example: (An update to) A generates +100% of (that update to) B and B generates -100% of A. When page A is read (for the first time and A is desired), the value of A becomes 100 and the value of B becomes 100. But because B is updated, it generates an update to A: A is decreased by 100. This update to A generates an update to B, etc.
2. It may be difficult to decide how to handle repeat visits to pages.
   Example: A generates +50% of B. When page A is visited for the first time the value for A becomes 100 and that of B becomes 50. We do not want the value of B to become 100 when A is revisited. On the other hand, if some other request decreases the value of A (and maybe recursively also of B) then a repeat visit to A should update B again. (See Section 5 for an example.)
3. One page access may induce two updates to a concept. If A generates +50% of B and +50% of C, B generates +60% of D and C generates +40% of D, then a (desirable) first access of A generates an update of +30 to D through B and another update of +20 to D through C. Both updates must be applied (correctly) in order to get a predictable (deterministic) result.

4. The Update Algorithm in AHA

The basic user model update algorithm is a simple recursive application of *generate rules*. In AHA a (single) *generate rule* is associated with each concept. So if a concept value is updated (and actually changed by the update), AHA will simply look at the *generate rule* for that concept to determine which other concept values to update. For each of these concepts the update continues recursively. As shown above this basic algorithm can be easily tricked into producing non-deterministic results or infinite loops. There are three easy ways to avoid loops, without giving up on having a recursive algorithm:

1. Disallow the definition of sets of *generate rules* with loops. Potential loops can be easily detected. Unfortunately, many "potential" loops may turn out to not actually be infinite loops, so the authoring system should not forbid their definition.

2. Allow each concept to be updated only once (per run of the algorithm). Unfortunately issue 3 above requires concept D to be updated twice.

3. Allow each *generate rule* to be used only once (per run). Issue 3 above can be easily extended with an update to a concept E that can only be done by applying a *generate rule* from D to E twice.

(Actually, rules 2 and 3 can be modified to allow some other number of iterations instead of 1.)
In AHA we have chosen a perhaps less intuitive but certain way to avoid infinite loops while ensuring deterministic behavior. We distinguish four cases:

- **monotonic update**: the update to the value of a concept induces an update (with a relative value) to another concept, with a "+" in the `genlist` field. The update algorithm then continues recursively for that concept. A monotonic clause in a generate rule is only allowed to update (the value of) an abstract concept, not a page concept.

- **non-monotonic update**: the update to the value of a concept induces an update (with a relative value) to another concept, with a "-" in the `genlist` field. The update algorithm performs the update but does not continue recursively for that concept. Again, non-monotonic updates are only allowed to update abstract concepts.

- **absolute update**: the update to the value of a concept induces an update to another concept, with a fixed value (no "+" or "-" in the `genlist` field). The algorithm performs the update but does not continue recursively for that concept. Only page concepts are allowed to have a generate rule with absolute updates.
- **self update**: the update to the value of a concept induces an update to the concept itself, by including the concept in its own "genlist". This does not recursively cause the rule for that concept to be executed again. A typical use of a self update is to make repeat page visits have effect on other concepts. Only page concepts are allowed to have a generate rule with a self update.

Consider the following example:

```
<genitem>
   <name>concept1</name>
   <genlist>concept1:0 concept2:+40 concept3:-30 concept4:50</genlist>
</genitem>
```

(From the restrictions we already see that concept1 must be a page concept, because it generates an absolute update.)

If the value of concept1 is augmented by X, the value of concept2 is augmented by 40% of X and the *generate rule* for concept2 will be (recursively) executed. The value of concept3 is decremented by 30% of X, the value of concept4 is set to 50, but the *generate rules* for concept3 and concept4 are not executed, and finally the value of concept1 is reset to 0 (so that repeat visits have an effect).

Note that in this example X may be a positive or a negative value, and independent of that the update to concept2 may recursively trigger other updates while the update to concept3 never triggers other updates.

By only (recursively) propagating monotonic updates, and by limiting (clipping) all updates to the range 0..100, the update algorithm is guaranteed to terminate. In worst case all values are initially zero and in each recursive step one abstract concept is augmented by 1. In this case the algorithm can run for 100 times the number of abstract concepts steps and then it stops because all abstract concepts' values are 100. So the algorithm always terminates in O(number of abstract concepts) time. In practice the time needed to perform the adaptation is negligible compared to that for sending the page to the browser.

The restrictions on the four types of updates are necessary to make the update algorithm deterministic. If A updates B and C and B and C would each perform an *absolute update* to D, with different values, then the result of the update algorithm (on D) would depend on the order in which the two absolute updates are performed. However, if the updates to B and C cause recursive steps then they must be monotonic and the restriction on monotonic updates then says that B and C must be abstract concepts. The restriction on absolute updates says that B and C are not allowed to generate an absolute update on D because only page concepts are allowed to generate absolute updates.

5. Examples

A first *general purpose* example is that of an "explorer"-like menu structures:

- first menu item
    - first submenu *conditionally* appears
    - ...
- second menu item
    - second submenu *conditionally* appears
    - ...

To implement a menu structure where clicking on a menu item opens up the submenu (and closes the submenus for other menu items) a set of *absolute updates* can be used. It is not actually the click that triggers AHA to update the user model, but the access to the page associated with the menu item.

```
<genitem>
   <name>firstmenu</name>
   <genlist>firstmenu:100 secondmenu:0 thirdmenu:0 ...</genlist>
</genitem>
```

Each submenu is then conditionally included as follows:

```
<if expr="firstmenu=100>
```

```
    <block>
       <ul>
       <li> first submenu conditionally appears
       <li> ...
       </ul>
    </block>
 </if>
```

A second *general purpose* example is that of grouping users. If certain pages are typically accessed by students, and other pages by faculty, then one can automatically detect whether the user is a student or faculty member. The Eindhoven University of Technology is currently building an adaptive central university website (with general information). Distinguishing groups of users automatically is one of the intended adaptive features. For a student page one writes:

```
 <genitem>
    <name>studentpage1</name>
    <genlist>studentpage1:0 student:+2 faculty:-1</genlist>
 </genitem>
```

Each access to "studentpage1" resets the "studentpage1" value so that the update is repeated for each visit to that page. So the small updates to "student" and "faculty" are repeated each time "studentpage1" is accessed. By augmenting (the value of) "student" and decrementing "faculty" each time a student-related page is accessed one indicates that the confidence that the user is a student and not a faculty member increases. Other pages or fragments can be made dependent on expressions like "student > faculty".

6. Conclusions and Future Work

Web-based adaptive systems need not be geared towards a single application or application area. AHA was originally built to make an on-line (hypermedia) course adaptive. After its redesign it is now being used in different applications, and its adaptation features are used to recognize user groups, to support explorer-type menus, and other aspects that are not necessarily related to the user's knowledge. The examples in Section 3 show how "concepts" and "knowledge values for concepts" can be used (some would say abused) to perform different types of adaptation. Other educational adaptive systems have a user model architecture that is similar to that of AHA: with knowledge values for concepts. By making it possible that accessing a page decreases the "knowledge" for some concept (as well as supporting increases to knowledge) other AHS can also be made more versatile.

The possible values that can be associated with a concept (in AHA) are limited to a single integer attribute with values between 0 and 100. While this enables us to define a user model update algorithm that always terminates with a deterministic result it is still limited. In the AHAM model for adaptive hypermedia systems (De Bra, Houben & Wu 1999), an arbitrary number of attributes (with arbitrary value domains) can be associated with each concept. The recent additions to AHA allow many (educational and non-educational) applications to be implemented using AHA, but in order to become truly versatile AHA needs to be augmented with facilities to define a user model with arbitrary attributes and value domains for each concept. When this will be done the method in which AHA avoids infinite loops and ensures deterministic behavior of the application of adaptation rules can no longer easily be generalized to such rich user models. Further research is needed to determine how to handle (recursive) user model updates for complex user models.

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Online Knowledge Communities

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Abstract: This paper describes the concept of Online Knowledge Communities. We define this concept and compare this type of communities to others. In addition, we present four guidelines for the design of online knowledge communities and we describe two projects in which we design and implement online knowledge communities based on these guidelines.

Introduction

Humans have a natural tendency for community (Gartner, 1995). With the rise of new information and communication technologies (ict), new possibilities to create or being part of a community become available. A concept that is becoming popular nowadays is online community where people are involved in social structures based on Internet technologies. The concept of community was originally related to physical space (Gardner, 1995). People were living together or were united by shared interests, religion, nationality etc. Today, the Internet makes communities global. Everybody with an Internet connection can build or be a member of an online community world-wide. The tendency for community is one of the main reasons for the establishment of such online social structures, wherein people can communicate, share information, interests and beliefs, with other people. Rheingold (1993) believes that online communities are in part a response to the hunger for community that has followed the disintegration of traditional communities around the world. At least, we may expect that online communities will become substitutes for traditional communities.

Nowadays, two dominant and contrasting uses of the term online community can be found (Jones, 1997).

- The first simply equates online communities with various forms of information technology for communication in-groups. Hagel & Armstrong (1997) for example define virtual communities as a computer-mediated space where there is an integration of content and communication with an emphasis on member-generated content.
- The second view holds that online communities are new forms of 'community' created via the use of various forms of computer-mediated communication. For example, according to Rheingold (1993) online communities are 'social aggregations that emerge from the internet when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace.'

Compared with the first view, technology in the second view is only a tool for community building, where the members determine the nature of the community. We prefer the second approach. The central quality of a community should concern people instead of technologies, as a community is seen as 'a group of people living together and/or united by shared interests, religion, nationality, etc.' (Procter, 1978).

In our research we are interested in the design of successful online communities and more specific in the design of online knowledge communities. We see online knowledge communities as the social structures wherein people will organize their professional development, their life long learning, their electronic performance support, their professional interests, etc. in the near future. There has already been documented a lot about online communities. However, a framework for the identification of online communities is still missing. In this paper, we present our framework and based on this framework, we describe our ideas about online knowledge communities.

Online communities

Many descriptions of online communities are available (for example: Janal, 1988; Ishida, 1998; Gill, 1998; Hagel & Armstrong, 1997). Analyzing the descriptions, we see six qualities of online communities:

- the members of the community: the user roles are clearly defined;
- mission: generally accepted goal-statement, ideas, beliefs, etc.;
- commitment: members give their loyalty to the mission;
- social interaction: frequent interaction between the members;
- mutually beneficial: participation is useful for themselves and other members;
- location: an online meeting place.

In this paper, we use the following definition of an online community: a group of people committed to a mission, who meet in frequent social interaction because it is mutual benificial by means of an online meeting place.

In our research, we use these six qualities to distinct types of online communities. Table 1 shows an exemplarily overview of communities.

Types / Qualities	Study community	Social community	Knowledge community	E-commerce communcity
Members	Students Teachers	Individual Internet users	Colleagues Employers Employees Experts	Consumers Corporations
Mission	Improving learning situation Improving contact	Creating and continuation of contact Creation of a 'home' for Internet users Performance of a social role	Making knowledge available Knowledge generation	Expanding Consumer market Providing one-to-one marketing Creation of clear defined markets Improving customer relations
Commitment	Knowledge domain Educational tasks Common learning goal	Social topics Particular theme	Knowledge domain Task execution Organizational culture	Question and demand Services and products Business culture
Social interaction	Documentation centre Forum Receiving and sending mail	Interaction: chatbox, newsgroups and adding content Entertainment	Knowledge bank User ID Search engine	Overview of products and services Order form Financial transactions
Beneficial	Educational	Non profit	Professional	Profit
Location	Intranet	Internet	Intranet Extranet Internet	Intranet Internet
Examples	Online study community Distance learning Virtual classroom	Online magazine Supporting organizations and sport team Interest groups	Professional organisation Service	Auction Ordering service Search machine Online shops

Table 1: An overview of online communities.

A member is a person belonging to a group (Procter, 1978). Members in a community have explicitely chosen to participate in the community because of a distinctive focus. People who are part of a community choose to identify themselves as community members (Bock, 1998). Depending on the reason of being a member, community members have different role models. Commitment can be described as the linkage between an individual and the organization or community (Mowday, Steers & Porter, 1982). Such a linkage leads to a strong belief and acceptance of the goals and values, a willingness to exert considerable effort on behalf of the community and a strong desire to maintain membership (Mowday, Steers & Porter, 1979). Everybody in a community should benefit from being a community. It is the concern of the members and the value they put into the community that decide the success of the community (Figallo, 1998). The notion of interactivity is central to virtual settlements (Jones, 1997). Social interaction in online communities is the communication between two or more human beings instead of human-computer interaction. According to Hagel and Armstrong (1997), interaction in a community is based on people's desire to meet four basic needs: interest, relationship, fantasy and transaction. Communication between members has to be organized in a virtual meeting place on the Internet. Members will continuously visit this particular site whenever they want to make virtual contact to community partners. If there are corporate or organizational reasons for the creation of a community intranet facilities could be used. To attract people with the same interest a community has to articulate a mission with a clear purpose and vision (Kim, 1999). The mission states what the community is all about and what members can expect. Utilizing a mission, designers of a community can create a foundation and members can build on it to maximize effectiveness (Foley, 1995).

Knowledge communities

As said, we are interested in the design of succesful online knowledge communities. In our view, such a community is a social structure wherein people organize their professional development, more specific their life long learning, their electronic performance support, their professional knowledge interests, their network, etc. in the near future. We define an online knowledge community as a group of knowledge workers jointly taking care for a knowledge domain, who meet in frequent social interaction for their professional development by means of an online expertise center.

We see knowledge workers as the principal members of an online knowledge community (okc). A knowledge worker can be described as someone who routinely uses information in his or her task performance (Based on Rochester, 1996). There are a number of member roles. Basically, we distinct the senior, junior, expert, and a tutor. Depending of the context of an okc, such roles can be more specified. For instance, in a university setting the members can be researchers, teachers, tutors, students, external experts, and graduates. The mission is taking care for a knowledge domain. A knowledge domain can be themes like project management, entrepeneurship, knowledge management and human resource management. Taking care of such a domain together implies activities like gather information, organise information, make information accessible, synthesize information, share information, transfer information, and synthesize information. The commitment is for the greater part driven by the need of knowledge workers to keep abreast of the nowadays rapidly and continually changing knowledge domains. Naturally, we may expect that there is also personal interest in the specific knowledge domain. Interaction activities are already referred to when we spoke about taking care of a knowledge domain. When we take again a university setting as an example for an okc, this interaction is principally meant to create knowledge (research) and transfer knowledge and skills (dissimination). Being part of an okc has to be benificial for themselves and others. We mention as the main benefit the professional development of the members. An okc is the basis for life long learning, performance support, exchanging ideas with fellow members, networking, etc. Finally, the online meeting place is described as an online expertise center. Such a center contains the well-described knowledge domain, the functionality needed for taking care of the knowledge domain, and an interface that enables the members to be a true member. Well-described means normally that the knowledge is stored in a database and that it is described by meta data so that it can be applied in a way that is needed. Functionality refers to information management, communication, teaching, publishing, communication, and co-operative work facilities. The interface is crucial for the usage of such systems and has to meet the usability standards.

Given this definition it is possible to distinct okc's based on for instance knowledge domains, the context of an okc, the functionality of the expertise center, etc. In the next paragraph, we make a distinction based on the context of an okc, because organization of communities will mostly be based on the context.

Types of online knowledge communities

Online knowledge communities can be divided in communities that are created for corporate reasons (corporate communities) and work or profession related communities (communities of practice). Also, people could be member of a social knowledge community because they are interested in a particular knowledge domain or because they belong to the target audience. For example because they have a certain age or they belong to a special interest group, for example because of their occupation. Corporate communities can further be divided according to their community space. Communities can be developed in and directed to one organisation (internal), between two organisations of the same (intra-organizational) or different (trans-organizational) companies and communities can be developed to create a relationship with people outside the organization (external). A special type of knowledge domain community is the community of practice. A community of practice is based on professional relations and research areas. Examples are teacher networks on the Internet where teachers can exchange information and material and share expertise. Compared with corporate communities that could also be work related these communities are not related to a specific (corporate) organisation. The types are described in Table 2

	Corporate community internal/ intra-organizational/trans-organizational			**Community of practice**	**Social knowledge community**
Members	Employers Employees Colleagues			Professional workers Professional colleagues Experts	Individual Internet users
Mission Commitment	Making knowledge available Knowledge creation Improve work and information processes Collaborative working			Making knowledge available Knowledge creation Collaborative working	Making knowledge available Knowledge creation
Knowledge domain	Internal affairs	Organizational affairs	Business affairs	Professional topic	Specific theme Target group issue
Structure Social interaction	Intranet	Intranet Internet	Intranet Internet	Internet Extranet Professional organization	Internet Service provider Municipality service

Table 2: A framework for the description of online knowledge communities.

The design of online knowledge communities

The next question is how to design okc's? Given the definition of an online community, a social structure enabled by an online expertise center, a socio-technical analysis model is used (Eason & Harkin, 1989). Designing a knowledge community requires attention to the technical as well as the social characteristics of the okc. Based on Eason & Harkin, the community has to meet four types of design guidelines. Original, these guidelines refer to a software system. We however apply them to an 'okc', a social structure mediated by an online expertise center.

The four main guidelines we distinct, are the following. The okc has to be functional; the okc has to include all the functionalities members need and has to support the user while being member of the community. The okc has to be usable; the members have to be able to perform easily with expected results. The okc has to be sociable; the members have to be able to be a communicative person in a comfortable environment. The oks has to valuable; members have to feel that the membership of an okc is useful. Each of these guidelines can be elaborated.

Here, we will describe two projects shortly, in which we are working on the design of okc's. In the project E-study Europe (Vries, Egeraat, & Bogdanov, 2000) we are working on an okc called E-study in an international university context. The project is going on till october 2000. In the project StudyCom (Roossink, Vries & Moonen, in preparation) we are working on an okc also called StudyCom for the secondary education context in the Netherlands. The project is expected to continue until september 2001.

E-study is primarily meant for university researchers, teachers, and students from three different countries, Poland, Germany and the Netherlands. The mission can be described as to enable students

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from different countries to work together on study projects and to intensify the understanding for each others cultures. The knowledge domain is the 'design and implementation of interactive media'. The commitment of the members is on the moment for the greater part based on the co-operation within the project. However, we expect that we will be able to continue the co-operation also after the project. In the period from may until september 2000 we start the pilot in which students and teachers have to interact frequently. The benefits for students as well as teachers is gaining experience in the use of modern technologies, exchange ideas and beliefs with other European countries and to work together in study projects. In this project, we make use of a sophisticated tele-educational infrastructure, consisting of a number of nodes in each op the participating countries. One of these nodes is the online expertise center ComMedia (Vries, 1999).

StudyCom is primarily meant for secondary education teachers and learners and researchers, teachers and students from the university study program Communication Science and external experts from cultural organisations. The knowledge domain is the study profile 'Society and Culture' of the Studyhome in secondary education in the Netherlands. The mission is to offer a usable information and communication learning platform to set up, look after, pass through and evaluate study projects and to offer a meeting platform to tune supply and demand on cultural services for educational purposes. The commitment of the members is mainly based on their need to work in this field for educational purposes. For instance, the learners from secondary education have to fulfill a number of assignments in this area, by making use of ict. We expect that the benefits for each member role will be significant. Learners will be able to make use of a a coherent information, communication, publication and collaborative work environment. Teachers are enabled to mentor learners, but also to co-operate with teachers from other schools. They also have the opportunity to attract local of national cultural experts in order to support learners. In this project also, we make use of the online expertise center ComMedia (Vries, 1999). The center is tailored to the secondary education context.

Both projects are examples of our work in the design and implementation of okc's. On the conference in november 2000 we are going to present our first member experiences in these communities.

Conclusion and discussion

In this paper we have presented our ideas about the design of okc's. We expect that online communities will become one of the main utilisations of the Internet. By working on a sense of community around a website, these sites can duck out of the mainstream of sites. Online knowledge communities are of specific interest, because in our knowledge society there is a hunger for situated information and for a continuing professional development. The idea of curricula, courses, modules will fade away and the idea of continuing learning when carrying out daily work activities will become significant. An interesting question is for instance, if universities will be able to play a role in this development.

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Attribute-Oriented Programming:
A New Method for Building Personal Agents

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Abstract: To enable computer literate people who don't know how to program in a "usual" programming language to build their own personal software agents, a new method of composing software agents is presented. An agent is defined by building a so-called attribute-tree, which also serves as the runtime representation of the agent program. The implicitly contained application-logic of an attribute-tree is analyzed and executed by a special runtime-environment, called the "MetaBus". The MetaBus is an XML-based lightweight distributed infrastructure which can be used as a "piggyback system" for existing and future IT environments. It allows software agents to utilize nearly all kinds of existing IT-services.

Introduction

Today's computer networks, intranet environments and especially the internet offer a tremendous volume of constantly changing information and services. In this situation, personal software agents - special programs, which represent their users inside a computer system and may (to a certain degree) act autonomously - could help users benefit from this situation. So-called "mobile-agents" (White 94) are able to move between computers in order to fulfill their tasks. Instead of being online all the time, a user could send a mobile agent into a server environment, where it may be especially useful to filter information and notify its user when something of interest happened: a so-called watcher-agent (Doemel 96).

If there's a problem whose solution might be useful to many people, surely somebody will be offering a service or a software application to satisfy this need. However, there are also situations, where it would be useful to have a program for solving a very particular task, useful only to a very small group of people, or even only to one. So it might not be worth the effort and cost to develop a new application, but it could be the perfect task for a personal agent, which might make use of already existing IT-services to do its job. Such an agent would represent a personal value-added service.

While much research effort had already been spent in the development of agent infrastructures - by the time of writing this paper, e.g., 71 systems for mobile agents were listed in (Hohl 99) - and on investigating the requirements of agent interaction (Doemel et al. 97, Cabri et al. 98) and security (Karjoth et al. 98, Fünfrocken 99), it is pointed out in (Bradshaw et al. 99) that "... *Perhaps more importantly, we must develop new sorts of tools to help non-specialists unlock the power of agent technology...*". This paper is addressing exactly this problem by presenting a new programming paradigm and the tools for enabling users, who don't know how to program in one of the 'usual' programming languages, to actually compose their own personal software agents from existing services.

Design Goals and Software Development Observations

While thinking about a new way of building software agents, a few additional criteria have been considered, in order for the solution to be also practical in the "real world":

1. Programming an agent should be as simple as creating a spreadsheet or programming a scientific calculator.
2. Access to all kinds of existing distributed services should transparently be provided to the agents by the same programming paradigm as is used to build the agents.
3. The programming model should, in principle, allow for the extension of the agent programs and integration of new functionality into their service environment during runtime.
4. The actual agent programs should not directly depend on the release cycles of the software infrastructure of the underlying services.
5. The necessary runtime environment should be relatively lightweight, and easy to integrate as a kind of "piggyback"-system with existing and emerging software-infrastructures.

In order to motivate the decision for introducing the paradigm of "attribute-oriented programming", first some well understood and widely used technologies for creating software in general are to be looked at from a bird's-eye view:

Compiler Technology

Many compilers internally often consist of the following functional units (Aho et al. 86): Lexical analyzer (scanner), syntax analyzer (parser), semantic analyzer, intermediate code generator, code optimizer, code generator, symbol table, error handling. The parser builds a parse-tree for an input program by applying the grammar rules of the programming language. Each node in this tree represents a programming language construct. To translate such a construct into the target language and do the semantic analysis, compilers that make use of syntax-directed translation mechanisms associate several additional data values with the nodes of the created parse-tree, e.g. for internal bookkeeping or storing semantic information like an expression's data type. These associated data values are called attributes and a parse-tree whose nodes also contain attribute values is called an annotated parse-tree (Aho et al. 77). Attribute values may also be synthesized from attributes of children-nodes by applying semantic rules.

A parse-tree (also called concrete syntax tree) usually contains a node for each recognized language construct. The lexical elements of the input program appear as the leaves of the tree. However, superficial distinctions of form and other redundancies can be removed from a parse-tree, thus reducing it to an abstract syntax-tree, in which a node represents an operator and its children represent the operands. Annotated abstract syntax trees can be built in such a way that they contain nearly all the necessary information to generate the code for the target language. (Fig. 1) shows an abstract syntax tree for a small code fragment written in one of the C-like languages (for instance Java or C++).

Figure 1: An abstract syntax-tree

Visual Builder Technology

The advances in object-oriented software development during the last ten years did not only bring advantages: the overall complexity of the programming languages' runtime environments and special purpose as well as generic class libraries grew remarkably. This is resulting in a steep learning curve for beginners. Various so-called visual development environments are available to help developers cope with their challenges. Some common examples are VisualBasic, Visual-C++, VisualCafe (Java), VisualAge (Smalltalk, C++, Java) and JBuilder (Java). They first came out to simplify the building of graphical user interfaces (GUI), and are meanwhile also used to support the construction of complex distributed applications (now often called "enterprise applications").

A very common technique offered by those visual development environments, is to let developers select graphical representations of objects or other software components (e.g. GUI elements) and drag them to some container component to create a new instance. Their appearance (and partially also behavior) may then be defined by simply setting some values of a set of so-called properties. Much of the work necessary during application development could thus be reduced to simply setting property values. The advances made in the field of visual development environments were some of the driving forces to push the component-oriented software development techniques forward (e.g. ActiveX-Controls and JavaBeans (URLs 00a). However, most of the dynamic and algorithmic behavior of the resulting applications still has to be "hand-written" in a programming or scripting language. Class libraries of today often are huge, and because of the interdependencies, which may exist between the classes, still a lot of knowledge about the language, the underlying system and runtime environment is necessary to build sophisticated applications. That's one of the reasons, why meanwhile many of the more complex interdependencies are hidden in code modules and framework components which are generated by the development environments, e.g., for CORBA, COM+ or EJB-based systems (URLs 00b).

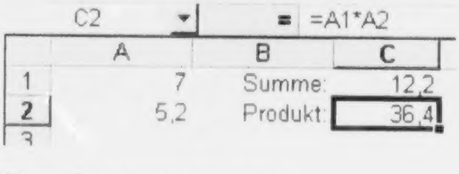
Scripting Languages

Languages like VBScript, JavaScript, Perl, Tcl, and Python (URLs 00c) became very successful because they usually provide simple, but in some respects higher level language constructs and data structures (e.g. associative arrays, regular expressions) than "ordinary" programming languages, thus reducing the number of lines of code to write. Usually they are more or less interpreted (sometimes also compile to an intermediate code which then is interpreted), allowing for rapid prototyping. One other big advantage of scripting languages is that they provide easy and convenient access to the tools and mechanisms of the underlying operating system or surrounding application (in case of embedded scripting environments, like e.g. Tcl, JavaScript of VBScript). These are the reasons why they often are preferred by system administrators and web-programmers.

Calculator and Spreadsheet Technology

Pocket calculators were some of the first electronic products "for the masses". People with a basic mathematical understanding were nearly immediately able to use them. Spreadsheet programs (like, e.g., VisiCalc) allowed people, to write their own calculation "programs" without the need to know something special about their actual computer system. The availability of spreadsheet and word processing programs helped the personal computers during the 1970's (e.g. Apple II, Radio Shack's Tandy TRS-80 or Commodore's CBM) to make it into business.

A spreadsheet is based on a data-centric view to the problem of programming calculation formulas. The data is stored in the cells of the "sheet". New data values are computed by defining mathematical expressions, which are based on the values of other cells. The cells are addressed via their column/row positions inside the sheet. (Fig. 2) shows a simple spreadsheet where the value of cell C1 is computed from the expression A1+A2 and the value of cell C2 is defined as A1*A2. That's all what's necessary to determine and display sum and product of A1 and A2 – the rest is done by the spreadsheet program.



C2 ▾ = =A1*A2

	A	B	C
1	7	Summe:	12,2
2	5,2	Produkt:	36,4
3			

Figure 2: A simple spreadsheet

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Attribute-Oriented Programming and the XML-Based MetaBus Runtime Environment

The following observations represent the foundations of the "attribute-oriented programming" paradigm:

- Compilers build tree-structures, whose node-attributes contain nearly all the necessary information to generate a complete program.
- Visual development environments allow specifying much of the appearance and structure of applications simply by defining values for component properties.
- Scripting languages are successful because they offer powerful yet simple data structures and provide easy access to external resources.
- Calculators and spreadsheets are simple enough to be used by many people not belonging to the group of software developers.

The design goals mentioned above were targeted by consequently restricting to a kind of common denominator of these foundations to obtain a simple method for building software agents, become manifest in these statements:

1. Instead of forcing users to write agent programs in one of the "usual" programming languages or a similar "new" one, simply let them build an abstract annotated syntax-tree directly.
2. Instead of generating code from this syntax-tree in the native machine language of a target system (e.g., Java byte-code or some assembly language) simply have a special distributed runtime system (called the MetaBus) interpret the program stored in such an annotated tree structure directly.

In doing so, the MetaBus may have the ability to internally make use of compiler techniques like semantic analysis, like using a suitable intermediate code system and optimization mechanisms which may lead to very powerful possibilities for distributed applications (like optimizing the execution of groups of agents as a whole).

Attribute-oriented programming is defined as "the process of creating an abstract annotated syntax-tree" (also called attribute-tree) in order to define a software program. An attribute-tree consists of "item-nodes". Except for one special node (the "root-node"), every item-node has got exactly one "parent-node" and may have zero or more "child-nodes". Every item-node contains a set of "attributes", where each available attribute has a "value" which can be addressed via the attribute's "name" (also called the attribute's "key"). Attribute-names always are string values. The set of all attributes belonging to an item-node is called an "item". An "item-tree" is a sub-tree with a specific item-node as its root. If an item-node contains a special attribute named "value", then the value of this attribute also represents the "value of that item-node". Otherwise, the value of an item-node is defined as "the entirety of all item-node values of its item-tree". Software-agents whose programs are represented as attribute-trees will be referred to as "attribute-agents". The runtime-environment for attribute-agents is called the "MetaBus". The MetaBus analyzes and internally generates the application-logic (in commercial distributed systems sometimes also called "business-logic"), which is implicitly defined by an agent's attribute-tree.

At first sight it may seem that above statement #1 is demanding a little too much of users, but the mechanics for building an agent are really simple: create node by node and characterize the semantics of each node by defining values of attributes. Of course, many constraints regarding the structure of such an attribute-tree have to be obeyed in order for the MetaBus being able to interpret the tree as a "program". To remove this responsibility from the user, a visual construction tool (the attribute-agent editor) (Fig. 3) is ensuring the consistency of all attribute-values during attribute-oriented programming and provides similar techniques, as common visual development tools do.

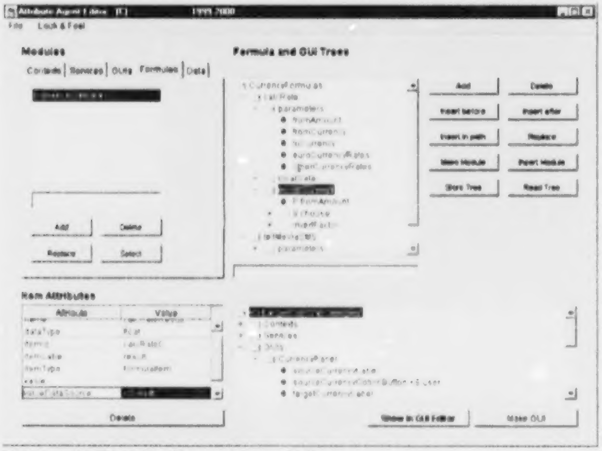

Figure 3: The Attribute-Agent Editor

When attribute-trees (representing data and mobile agents) are to be exchanged between processes, computers and interfaces to external services, they are serialized using XML (Pardi 99), which turned out to provide a quite natural data format for that purpose. To make the construction tool completely configurable, a DTD (which will be called "XAgent") is currently being developed by the author to represent a comprehensive description of all structural constraints for attribute-agents.

There is always a trade-off between building a system using low-level concepts which are simple to understand and use, but usually requiring many single pieces to describe the solution, and using high-level concepts which carry a lot of semantics and require less components to describe the solution, but often can only be used in special contexts and are more difficult to learn. The attribute-oriented programming paradigm clearly resolves this in favor of the simple mechanics. This is because the main application area for attribute-oriented programming is the composition of value-added services from arbitrary existing external IT-services. The MetaBus serves as the homogenizing 'glue' between the distributed services by providing a consistent view of them (in this respect, the MetaBus serves as a kind of distributed middleware, which is a consequence of above statement #2): every service is represented as a set of functions, each of which taking some item-trees as arguments and producing exactly one item-tree as result. High-level semantics usually does not have to be defined by the user who is building the agent, but is

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already provided by the utilized external services, which hide the complexity behind simple interface functions. Therefore, attribute-oriented programming can be regarded as a kind of "distributed scripting of arbitrary IT-services".

External services are connected to the MetaBus with the help of interface-adapters (Fig. 4) by using different kinds of suitable inter-process-communication mechanisms. Different segments of the MetaBus are connected to one another and to the Internet with the help of proxy-web-servers. The protocol used to transport the XML-encoding of attribute-trees between different computers is HTTP. In principle, all services connected to any segment of the MetaBus are available to an agent-programming user. In many cases interface adapters will be manually implemented by software developers of the service-providers or the provider of the MetaBus-infrastructure, so the user doesn't have to care.

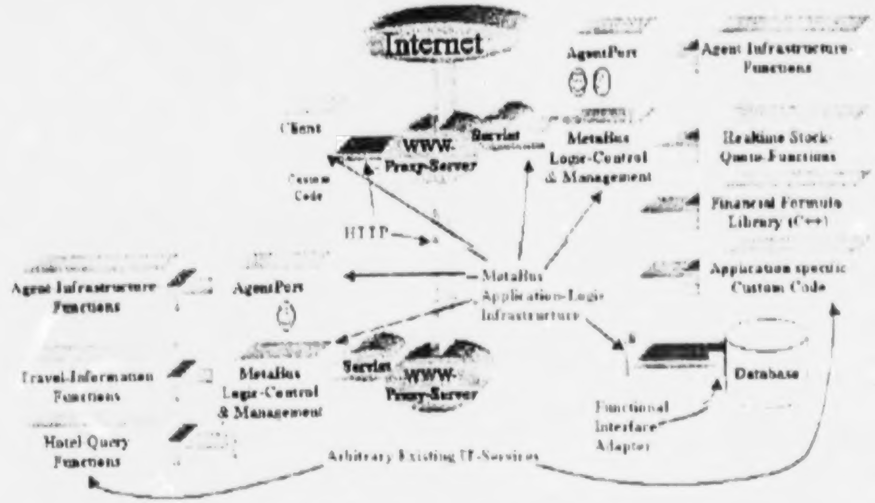

Internet
AgentPort
Agent Infrastructure Functions
Client
WWW-Proxy-Server
Servlet
MetaBus Logic-Control & Management
Realtime Stock-Quote-Functions
Custom Code
Financial Formula Library (C++)
HTTP
Agent Infrastructure Functions
AgentPort
MetaBus Application-Logic Infrastructure
Application specific Custom Code
Travel-Information Functions
MetaBus Logic-Control & Management
Servlet
WWW-Proxy-Server
Database
Functional Interface Adapter
Hotel Query Functions
Arbitrary Existing IT-Services

Figure 4: The MetaBus Architecture (including example services)

However, they could to a certain degree also be generated from the item-trees, which declare the available service-functions to the MetaBus, which in turn serves as a kind of interface repository for the construction tool, which finally exposes the available service interfaces to the agent-programming user. The MetaBus would then serve at the same time as interface repository and IDL compiler what is another consequence of above statement #2. Interface-adapter programmers can also make use of the "universal argument mapper", a MetaBus-internal convenience class, which allows the transformation of arguments for so-called legacy-services. It is a collection of data mapping and encoding functions that allow converting data into many different formats using the item-trees as intermediate data format. Because "everything is an item-tree", the MetaBus internally only has to deal with item-nodes and attributes. So all the mechanisms used inside of the MetaBus are quite simple. That's the reason, why the MetaBus is a "lightweight"-infrastructure, which can easily be added to existing IT-systems: only some interface-adapters have to be provided.

Attributes

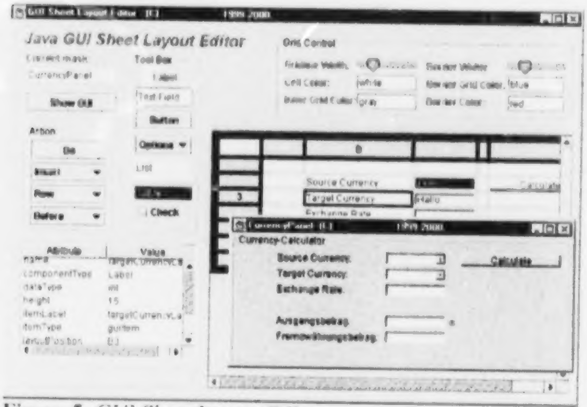
Usually the kind and number of attributes stored in an item-node varies and depends on the semantics of that node, but there are two attributes which are present in every item-node: The "itemType" defines the type of the item-node. This type on one hand determines the constraints regarding all the possible and mandatory attributes and attribute-values of that item-node and on the other hand is used by the MetaBus to determine the semantics of that node and to select a special internal processing object (the "item-processor") which will provide the dynamic behavior for that node while the attribute-agent is executing in the MetaBus. The "itemId" holds a value, which can be used to uniquely identify an item-node inside the whole attribute-tree representing the agent program. In addition to those "ordinary" attributes, there is a set of common attributes whose values will be dynamically generated by the MetaBus, when they are queried for their values: "numberOfChildren", "parentNode", "firstChild", "lastChild", "previousSibling", "nextSibling". Other common attributes are "name" (used to give a meaningful name to an item-node and can also be used to address the item-node) and "itemLabel" (text to be displayed by the construction tool).

As already mentioned, there often is a "value"-attribute, which represents value of the whole item when the item-node is used as function argument. All function arguments must either be literal values or references to item-trees. The result of a function evaluation is always an item-tree (in many cases consisting only of the root item-node which contains a value-attribute). The value of a "value"-attribute can either be given as a literal value or it can be dynamically computed by specifying a function call or a reference to another item-node as its value. This is the one and only mechanism how the application-logic of an attribute-oriented program is implicitly defined! In its effect the behavior of an executing attribute-oriented program is very similar to that of a functional program (Peyton Jones 87). The MetaBus internally creates a dependency graph and does a dataflow-analysis before starting to evaluate the dynamic attribute values. The evaluation procedure usually works as follows: a function will automatically be called by the MetaBus if the value of one of its arguments has changed (or the function would otherwise produce a different result depending on external events), which may cause the assignment of a new value to the attribute which specified the function call. If this attribute itself is an argument of another function, that function depends on it and the change will trigger the next evaluation. The MetaBus may also monitor external values, whose changes may trigger agent activities.

Structure of Attribute-Agents

Item-trees representing attribute-agents consist of the following sub-trees (Fig. 3):

- Contexts: contains item-trees, which hold user- and environment-specific information for the MetaBus runtime, e.g., database identifiers, IDs, passwords, and so on.
- Services: contains item-trees, which declare the signatures and namespace-aliases of external functions used by the agent. These usually are implemented by external services, but also include the declarations of internal MetaBus runtime function modules, which provide lots of mathematical operator functions, but allow more explicit control over the application-logic and agent mobility.
- GUIs: contains item-trees, which define GUI panels. Many agents don't need to provide a GUI, but for some it might be very useful to "talk" to their user. GUI-elements like text-boxes, labels or buttons are also represented by item-trees. User-interaction will cause changes of attribute-values. To help users create GUIs, the construction-tool offers a spreadsheet-like GUI-editor (Fig. 5). Currently, only Java-Swing GUIs can be generated from the item-trees, but in principle, also other GUIs could be supported.
- Formulas: contains item-trees, which define the agent's internal functions. The "formulas" have to be completely defined as item-trees by the agent programmer. They may also be made externally available by the agent (exported as new services for other agents). This tree must contain the "run"-function, and may also contain the "initialize", "die" and "finalize" functions (all used by the MetaBus to manage the agent's live-cycle).
- Data: contains item-trees, which represent the dynamically computed data whose implicit evaluation-dependencies define the application-logic of the agent.



Cell Color: white
Border Grid Color: blue
Inner Grid Color: gray
Border Color: red

Attribute	Value
name	targetCurrencyLa
componentType	Label
dataType	int
height	15
itemLabel	targetCurrencyLa
itemType	guiItem
layoutPosition	E3

Figure 5: GUI Sheet Layout Editor

In order to compose an attribute-agent, the problem to be solved has to be viewed at from a data-centric point-of-view, as it would have to be done when designing a spreadsheet. The process of "programming" is reduced to simply decomposing the problem into small pieces of data-values, which are evaluated by applying functions on other data-values. The only remaining problem to the user is to determine how to obtain these data-values. The actual creation of the agent's control-flow (the agent's application-logic) is to a certain degree delegated to the runtime system. To help the programmer distinguish the semantics of the item-nodes, references to item-trees are usually specified by prefixing the value of the root node's "name" attribute with one of the following letters followed by a ":" - C (Contexts), S (Services), G (GUIs), F (Formulas (local functions)), D (Data), P (Parameter of current formula), L (data item local to current formula), V (predefined Value (usually a global constant)).

Example: A Simple Personal Agent

Assume the following situation: Sandy is a teacher giving a course in "attribute-oriented programming". Her school provides a web-based lecture system, where the students can access Sandy's chapters via the Internet. At the end of each chapter, there is a multiple-choice test (provided via an HTML-form). When the students submit the forms, their results will be stored in a database. The teachers have a simple client-program to view at the results in this database. Sandy usually only starts evaluating the results of the tests, after the last student has submitted the form. So usually, Sandy had to look up the database once in a while to see how many results were still missing. Now her school has installed the MetaBus and a system-programmer has written an interface-adapter to the tests-database (among others offering the service-function "numberOfSubmissions()"). Sandy used this occasion to program a little attribute-agent, which will monitor the submissions of test-results and send a message via SMS (Short Message Service) to the display of her cellular phone to inform her when all results are available, before it dies.

The main parts of this attribute-agent visualized in a simplified tree notation in (Fig. 6) (usually it would not be displayed in such a "confusing" way, but browsed using the construction tool). When Sandy sends this agent into the MetaBus of the server where the database is located, she provides her mobile phone number and the number of students in her class to her agent via item-nodes of the "Contexts"-sub-tree. Sandy used the "dummy"-variable "allDone" to implicitly control the sending of the SMS-message and the dead of the agent, but she could alternatively also have moved part of this behavior into the loop of the "run"-formula. The next agent Sandy is thinking about will automatically evaluate all the tests and send emails with the score to the students...

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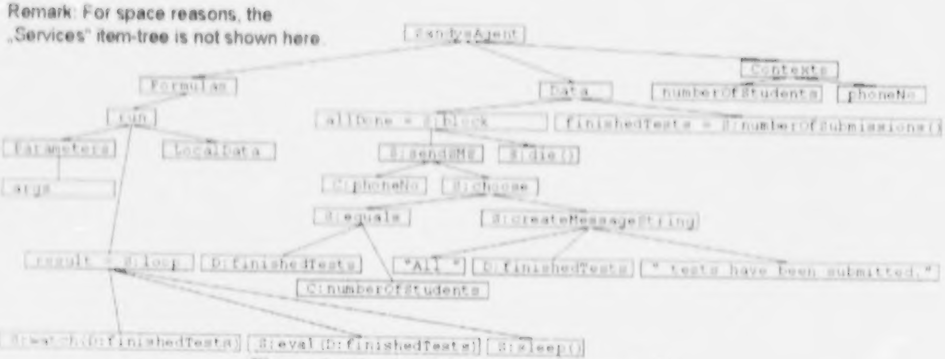
Remark: For space reasons, the „Services" item-tree is not shown here.

Figure 6: "Sandy's Agent" (the main parts of it)

Conclusion

This paper has presented a new way of building software agents. When looking at Sandy's example agent for the first time, it might seem to people who are used to imperative programming languages (like C and Java), that composing an attribute-agent looks confusing and tedious, but this is only a matter of habit. For users of spreadsheets the method might be more familiar, but they also have to get used to the prefix-notation of expressions: the operator comes first (root-node) and then its arguments (the child-nodes). Further context-sensitive improvements of the construction tool will help to simplify the process of setting attribute-values by providing sensible defaults. Sandy's agent was a tiny example, but attribute-agents of this kind could also be used to monitor, e.g., the development of a stock-portfolio and the arrival of flights.

Attribute-agents can also be easily sent from servers into Java-applets (bringing their own GUI with them). This way, simulating something like a distributed spreadsheet or a distributed multi-tier application is straight forward by simply using the standard mechanisms of attribute-oriented programming and the transparent remote function calls of the MetaBus (which is tunneling the XML-encoded attribute-trees through HTTP).

A few remarks regarding the initial design goals: 1, 2, and 5 have already been addressed. Concerning goal 3 it should be mentioned, that attribute-agents can be moved like data-items (they are, in fact, only simple XML-structures), because "everything is an attribute-tree": data, formulas and context information as well as GUIs. For the same reason, they can also be extended during runtime by simply adding another sub-tree, but they may also be transparently cut into several pieces by the MetaBus and distributed over several host-systems, while still acting as one agent (connected via the MetaBus). Goal 4 is met by moving the maintenance responsibility from the agent programmer to the provider of the MetaBus infrastructure, who will have the task to update the interface-adapters after version-changes of the underlying services.

Currently, the MetaBus exists as a proof-of-concept implementation (partially in Java and C++). Besides working on the XAgent-DTD and the interface-adapter generators, it is planned to slightly extend the programming model with a special event mechanism to give the agents a little bit more control.

In order to be better able to judge about the practicability of the approach, still more experience with "real-world" agents is necessary, but the optimization potential of the MetaBus already seems very promising.

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URLs (2000b): *CORBA*: http://www.omg.org/, *COM+*: http://www.microsoft.com/com/tech/complus.asp, *EJB (Enterprise Java Beans)*: http://www.java.sun.com/products/ejb/

URLs (2000c): *VBScript*: http://msdn.microsoft.com/scripting/vbscript/default.htm, *JavaScript*: http://developer.netscape.com/tech/javascript/, *Perl*: http://www.perl.org/, *Tcl*: http://www.teltk.com/, *Python*: http://www.python.org

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A Meta-data Driven Approach to Searching for Educational Resources in a Global Context

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Abstract: As more and more educational services (e.g. on-line courses) and learning resources become available on the Internet today, it becomes increasingly difficult to identify those services or resources, which are of genuine relevance to the learner. Current Internet search services generally return very large numbers of results and it is left to the learner to glean the relevance of these selections. With the increased globalisation of the educational marketplace, this problem will become even more difficult. This paper proposes the design of a meta-data driven search management system for educational resources. The paper describes the design of an on-line educational brokerage service, which assists learners in identifying appropriate educational resources with greater accuracy than today's Internet search engines. The paper describes a novel XML/RDBMS implementation of the search management system and outlines the experience operating such a system on the Internet today. The paper concludes by providing observations on current IEEE standardisation for educational metadata and educational search services.

Introduction

A major impact of the Internet and more particularly the World Wide Web has been to assist the 'Globalisation' of services and markets. This has been seen in many eBusiness based ventures, from electronic retail (e.g. amazon.com) to interactive service e.g. stock exchanges and electronic trading. Globalisation is also beginning to influence the educational community. Morrison points out that "the globalisation of economic activities is forcing all nations to establish wider access to learning using communications technologies to create an 'educational options map' involving the cost, scale, quality, relevance, portability, futurity, flexibility of an access to education" (Davis 99, Morrison 95). There are many challenges in an evolution toward global educational markets including cultural, economic, political, social and technical. Although it can be argued that such globalisation may not be appropriate across *all* educational domains, it's growth is certainly evident in tertiary level continuing education and in lifelong learning. From a technological perspective, many issues must be tackled e.g. standardisation between interfaces of educational systems and services, standardisation of description of educational resources and services to enable identification and enable appropriate choices, brokerage services to support potential learners in navigating the maze of WWW offerings and providing some guidance for choice. This paper focuses on services to support learners/tutors in identifying and choosing courses or learning objects (resources) in a global context. Current search approaches e.g. Internet search engines provide only basic search parameter matching and relevancy of retrieval is poor. The approach adopted in this paper is that of a supporting independent educational broker(s) who can provide prospective learners or tutors with an informed, independent view of many educational offerings/resources. The proposed search management system returns more precise search results and provides better precision based on the learners requirements. From the educational service provider's perspective, the brokerage service can provide a cost effective means of attracting learners from different geographical and cultural areas. For example on the internet today, 'knowledge portals' are beginning to appear where separate organisation(s) have been set up to market their on-line learning programmes and products from various educational providers.

This paper presents the design of an Internet enabled search service, which support educational resource discovery within an educational brokerage service. More specifically it presents the design and implementation of a meta-data driven approach to implementing the distributed search and retrieval of Internet based educational resources and compares its performance with current search services e.g. Internet search engines. The search system, although trailed in a pilot educational brokerage service, could also be used across any set of federated educational providers who support explicit metadata descriptions of their resources. However, in this paper we focus on a separate brokerage service applied within the educational domain. The paper first presents a business model, identifying the possible different actors in the context of a global educational open market. The paper then outlines an architecture, which reflects this model. In focusing on the role of the educational broker, the paper examines the current state of the art with respect to a meta-data driven approach to educational content description. More specifically the paper concentrates on the meta-data driven search and retrieval issues when designing, implementing and trailing such a brokerage search manager. The paper concludes with its experiences with operating such services in a pan-European trial as part of the European Research project GESTALT (HREF 1).

A business model & architecture for educational brokerage

Ideally, in a global open market there would exist a (standards based) framework for the development of compatible, heterogeneous, scalable, and distributed educational systems globally distributed across institutions and organisations. Such a framework would allow individuals to discover the existence of desired educational resources and have these resources delivered remotely over established networking infrastructures via a managed learning environment. One approach to realising this framework would be to analyse the potential organisation types and actors (roles) and interaction between these actors (relationships), which would form such a global vision. Such a vision is sometime called a 'Business Model'.

The European Research Project GESTALT analysed the requirements and influences in offering WWW based commercial educational services and distilled this into the GESTALT business Model. The authors do not claim this is the only Broker model for Global Education Services, but it is one based on current commercial / Educational influences from the internet. Several other models are possible e.g. consortia of educational service providers combining to offer branded educational resources or learning programmes. The GESTALT Business Model describes the roles involved in an Educational process and the relationships between these roles. In figure 1, the boxes represent the roles and the lines with circled numbers represent the relationships between roles.

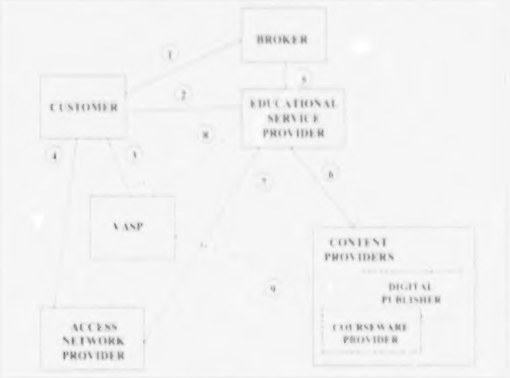

Figure 1: GESTALT Business Model

It is important to realise that there need not be a one-to-one correspondence between a role and an organisation. In fact in realising such a model, several roles can be played by a single organisation. The following is a brief description of the roles played in the GESTALT environment.

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Roles within the GESTALT business model

Customer - at the heart of the GESTALT Business Model is the Customer. An individual or organization playing the role of customer in the GESTALT environment is the entity wishing to discover the existence and location of an educational resource and/or actually participating in a GESTALT educational session.

Access Network Provider – by its very nature the GESTALT environment is distributed with the various GESTALT roles being played by actors residing at different locations. The Access Network Provider is the organization providing the physical links and network services required to link together the various actors playing GESTALT roles.

Broker – an electronic broker can be defined as an on-line entity that supplies specialized services or products, or information about such services/products to customers wishing to discover or purchase them. In the GESTALT environment the service/product will be the Courses and Resources (either as discrete components or packaged into an educational session) or learning programmes offered by an educational service provider and the customer will be the entity functioning in the GESTALT role of Customer wishing to discover the existence of an educational resource or set of educational resources meeting customer defined search parameters.

Educational Service Providers – the educational service provider is the entity providing educational services to the GESTALT role of customer. The responsibilities for this role can be classified into the following three categories:

- Learning Object Management - providing structured storage and management of learning objects
- Learning Object Delivery - providing an on-line environment for the delivery of learning content in the form of learning objects to the GESTALT customer.
- Student Tracking - providing administration facilities to handle the registering and course progress of educational sessions followed by customers registered with the educational service provider.

Value Added Service Provider (VASP) – the GESTALT role of value added service provider will provide User Profile Services to the GESTALT roles needing such services. A user profile provides a common point for the structured consolidated storage of information about an individual and all of the educational and vocational experience obtained by the individual.

Content Provider - the individual or organization actually producing and making available the educational content comprising learning objects.

In the business model where a consortium of educational service providers, the brokerage role can be managed by an independent company or be offer virtually by one of the consortium members (usually prime partner in the consortium). In this paper we focus on the Search Management aspects of the broker. We analyse the requirements and interactions with the Learner and Educational Service Provider. In the model, the Learner (customer) uses a brokerage site to identify educational offerings, which are suited to her. The brokerage service provides retrieval of learning programmes/objects more relevant for the learner's requirements. The search manager presented in this paper uses a meta-data driven approach to resources identification and is based on emergent IEEE standards in educational meta-data. The next section outlines the current state of the art in educational resource modelling and then presents the design and implementation of a standards based educational brokerage service.

Using Meta-data for Educational Search Management

Currently there are several international initiatives in the area of learning technology and learning object (resource) modelling. Principal among these is the IEEE Learning Technologies Standards Committee (LTSC) (HREF 2), which has formed a working group to create a standard for Learning Object Metadata (LOM) (HREF 3). This work has been heavily influenced by several research initiatives both in Europe and US. The Instructional Management Systems (IMS) (HREF 4) project is a US initiative, originally driven by EDUCAUSE, which incorporated 600 educational institutions across the USA. A second significant research initiative was ARAIDNE (HREF 5), a research project funded under the EU Telematics Programme. Both of these initiatives have influenced the early design of the LOM. Subsequently other research projects and organisations have also contributed to the standard e.g. GESTALT, moving LOM to its current relatively stable state. Another significant research initiative in the area of metadata has been the 'Dublin Core Metadata Initiative' (HREF 6) whose approach is 'aimed at achieving generalised interoperability across interest/subject domains and is focused on resource discovery'. Because of Dublin Core's 'cross subject' approach (i.e. applicable to many problem domains) their first set of meta data attributes were both limited in number and structurally simple. However, the group is currently working on a draft specifically for the Educational domain.

The major components of such Education metadata as defined by the IEEE LOM are:

- **General** - Groups all context independent features plus the semantic descriptors for the resource e.g. description, author, domain
- **Lifecycle** - Groups the features linked to the lifecycle of the resource e.g. version, creator of the course, publisher, title, …
- **Meta-metadata** - Groups the features of the description itself (rather than those of the resource being described) e.g. creator of the metadata
- **Technical** - Groups the technical features of the resource e.g. format of the resource, size of the resource
- **Educational** - Groups the educational and pedagogic features of the resource e.g. pedagogical type, semantic density
- **Rights Management** - Groups the features that depend on the kind of use envisaged for the resource
- **Relation** - Groups features of the resource that link it to other resources e.g. identifier of related resource
- **Annotation** - Allows for comments on the educational use of the resource e.g. person, description, date

A detailed breakdown of the LOM structure can be found on the IEEE web site (HREF3), a brief overview of the standard reveals: There are 101 elements in version LOM version 2.5 and all elements are optional; There is no required subset of metadata attributes; The Dublin Core metatdata elements are all represented in the LOM structure but are grouped differently; The LOM is structured into a hierarchy and its format is expressed in XML. On first reading the standard, the meaning of each element is not always clear, nor are the values required for certain elements are not always clear; the model is extensible for future evolution. The search manager described in this paper utilises LOM v2.5 and conclusions as to it usefulness and operation for resource discovery is discussed in the final sections of the paper.

Architecture

The purpose of the Broker is to provide a reliable gateway through which potential students can be referred to quality Courses and Resources. The students must have confidence that the Broker will point them at dependable courses and resources therefore unlike search engines only content from a relatively few quality assessed providers need be offered. Since Courses and Resources may exist on other networks the Broker cannot be limited to the WWW e.g. Z39.50 provides a valuable mechanism for accessing the wealth of information available in existing library systems. A major component of the Broker is a search facility similar to that offered by today's search engines. Whilst current search engines do an admirable job of indexing the majority of the WWW and offer solid text search functionality over HTML, their results often lack precision. To provide a more accurate search facility the Broker is required to prompt the user with domain specific information, which will help in the specification of a more precise search. To personalise searches for users the Broker is required to store profile information e.g. a user's preferred spoken language. Facilities for the previewing, and ordering of courses and Resources are also of use to perspective students and are therefore Broker requirements.

The key element of any Educational Search facility is the data about the courses and resources that are offered, in other words metadata about the courses and resources. HTML the ubiquitous data format for the web, is very successful at marking up text to be displayed on a browser. However HTML does not facilitate marking up with domain specific information. The W3C (HREF 7) proposes that XML be used to address this limitation and since domain specific information is a key requirement of the Broker, XML was adopted to facilitate its provision. This domain specific data provides a common schema through which authors and users can better communicate.

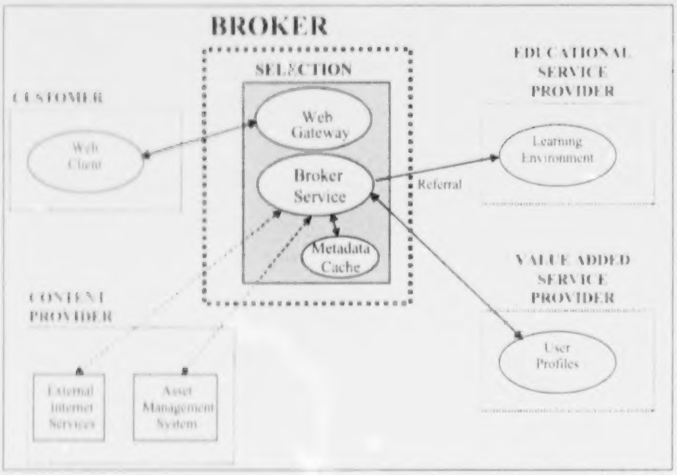

Figure 2: Implementation Architecture for the Educational Broker

The Broker depicted in Figure 2 uses a standard three-tiered architecture. The First Tier is a Web Client for use by the potential learner, the middle tier contains the application logic of the Broker Service, and the third is a metadata cache of educational courses and resources. The other components in Figure 2 are components from the GESTALT business model, which are external to the Broker. A thin **Web Client**, provides a Graphical User Interface for interaction with the rest of the Broker Service. The Web Client is used for the entry of registration, search, course preview, and course order requests. These requests make calls to correspondingly named Server Manager Objects in the **Broker Service**. The first of these Objects is a Registration Manager which governs access to the system, standard login and logout, as well as caching of user profiles. The Registration Manager can if required interact with a **Value Added Service Provider** to access centrally stored user profile information. The second Object is an Education Search Manager which accesses a cache of Course and Resource metadata, and provides search facilities over that cache. The metadata is cached in order to provide adequate performance. This cache of metadata is obtained by downloading metadata at regular intervals from different **Content Providers**. Backend Agents in the Broker Service are used for this gathering process and these Agents are similar to the Web Crawler's used by today's Search Engines. However, content providers are not restricted to Web Sites as they can be a database, a Z39.50 based library system, or any other system which stores Course or Resource metadata. The Agent is responsible for any protocol conversion issues and converting the data in the Content Provider to XML. Where the Course and Resource data to be retrieved by an Agent is not a format the can readily be converted to XML, a metadata conversion tool can be used along side the Agent to generate appropriate XML metadata (Kenny99). The final Object in the Broker Service is an Order Manager which interfaces with the **Educational Service Provider** to facilitate student referral and course ordering.

In order to satisfy the requirements for the ordered and previewing of courses, the Broker defines protocol independent interfaces. Further interfaces are defined for the connection of backend Agents. The main parameter in most of these interfaces is the XML metadata, other parameters include standard URLs for the identification of courses and resources, and a free format text string for user names. Because most of the application specific information is contained in the XML the defined interfaces have relatively few parameters and should NOT change significantly with time.

Trial broker implementation

The Broker was implemented for the GESTALT trial using a number of technologies including XML, CORBA, LDAP, and a Relational Database. The Broker is designed as a distributed system and therefore CORBA, Common Object Request Broker Architecture, was selected to facilitate communication between the various components. In a large configuration where the course metadata needs to be allocated across many machines, the CORBA Trader is used to select appropriate physical instances of the Broker. The Broker was successfully demonstrated to international external reviewers and the European commission in November 1999, and has been operating over a period of four months across several institutions.

At the outset of the project it was unclear which (educational) metadata schema would be used. However, if the Broker could store any metadata schema then it could be used for any metadata driven application not just Education. The Education Search Service is therefore able to store and search any XML data schema and is not restricted to the LOM. The cache keeps sufficient of the original XML data to be able to provide the Web Client with the following information:

1. Which DTDs schemas are available for searching. Each DTD schema can be thought of a single application domain, due to time and other constraints no attempt was made to map between different metadata schemas or different versions of a single schema.
2. Which elements exist in a given DTD and therefore which elements exists for a given domain.
3. Which data values exist for a given element, useful where the number of data values is small e.g. a list of all Universities.

None of these features are available in today's Internet search engines. These facilities assist the user in defining a very precise search in accordance with the selected schema, with today's search engines a user does not received any such domain specific assistance.

The Broker offers three types of searches of increasing precision. The first is equivalent to that offered by many of today's search engines, the second makes use of the metadata structure to focus the search into a section of the XML, and the third adds user profile information. The three types of searches are referred to as Internet search, metadata search, and compound metadata search. The metadata search offers the user a list of element names from the selected metadata schema e.g. Title, Description, Author etc. The user is then able to perform searches on these elements e.g. Author CONTAINS "Smith" or Keyword CONTAINS "C++". The compound metadata search automatically adds user profile information, which can come from a centralised profile management system, refining the search the user entered e.g. the condition "Language = Italian" would be automatically added if the users preferred language was Italian. This compound metadata search will be more precise then the metadata search. Standard Boolean operators are supported e.g. AND, as are standard comparison operators e.g. Greater Than. The Web Client can offer these searches either as a command line interface or as a Graphical User Interface which prompts the users with the different domains, element names, and element values.

JAVA as selected as the programming language for the Broker Management Objects and a Relational Database was used for the metadata cache. By using JAVA and JDBC, the search facility is easily ported to different operating systems and relational DBMSs e.g. the Education Search Service was ported from NT and Microsoft Access to UNIX and Oracle with minimal code changes. A JAVA Database Object was coded which made use of JAVA reflection to create SQL commands so that persistent images of objects could be stored in a Relational table. All persistent Classes were derived from the Database Classes and inherited the ability to create themselves as a table in the Relational Database. Instantiated objects of these classes had the ability to read, write, delete, and update themselves to/from rows in the Relevant Relational table. This technique made the creation of new persistent objects and changes to the elements in persistent objects very easy, it also made the creation of a new database very straightforward as all tables were created automatically from the Java code.

The metadata cache / mapping XML to the relational model

The major goals for searching the cache were acceptable performance, flexibility of searching with as much domain specific knowledge as possible, and the ability to ignore the structure of the XML and to search all the element values individually. It was known that XML could be stored in a relational DBMS and that RDBMS's offer a powerful query languages. Further the Authors are of the opinion that existing technology should be used were ever possible and therefore the decision was taken to attempt to store the XML in a RDBMS and map the inbound user query to SQL.

Sample Conversion of XML into an SQL table

This example illustrates the major ideas involved in storing XML in a Relational database and how the querying of that model works. Consider the following XML sample:

```
<Student>
        <Name>
                <First>Paula<\First>
                <Last>Jones<\Last>
        <\Name>
        <Mentor>
                <Name>
                        <First>Sarah<\First>
                        <Last>Murphy<\Last>
                <\Name>
        <\Mentor>
<\Student>
```

This sample is a piece of Student information about someone called "Paula Jones", who has a Mentor called " Sarah Murphy". There are a number of note worthy points in the XML structure. Firstly there are element names e.g. Student, Name, First etc which must be presented in any structure which stores the XML. Secondly there are different levels in the XML "Student" is at the highest level or level one, whereas Mentor is at low/deeper level, level two. Note that "First" is both at level three and at level four and that the difference between the two levels is significant. At level two "First" implies the Students name and at level four "First" implies the Mentor's name. Another way to look at this difference is to consider element names and expanded element names, both have a element name of "First" and have expanded element names of "Student.Name.First" and "Student.Mentor.Name.First" respectively.

One possible way to represent the XML in the relational database is to store the XML document locations in one SQL table, expanded element names in a second SQL table, and the element values from the XML files in a third. Thus we have the three tables:

XML Info Table

ID	Location
1	www.cs.tcd.ie/patient.xml

Element Value Info Table

XML ID	Expanded Element ID	Value
1	3	Paul
1	4	Jones
1	7	Sarah
1	8	Murphy

Expanded Element Info

ID	Element Name
1	Student
2	Student.Name
3	Student.Name.First
4	Student.Name.Last
5	Student.Mentor
6	Student.Mentor.Name
7	Student.Mentor.Name.First
8	Student.Mentor.Name.Last

Each time a new XML document is processed a single new entry representing the document location is added to the XML Info table and for a given DTD schema each element is represented uniquely by one row of the Expanded Element Info table. The possibility that two DTD schemas can use the same top-level name has been ignored. (This can be solved by adding a DTD ID to the table and modifying the query language to specify the required DTD(s).) For each data value in the XML fragment a new row is added to the Element Value Info Table.

Querying the cache

An example of a search that could be entered into any of today's search engines is:

Paula AND Jones

The Search Manager maps such a query to the following SQL statements:

```
SELECT DISTINCT    XMLInfo.Location
FROM               ElementValueInfo , XMLInfo
WHERE              ElementValueInfo.xmlID = XMLInfo.ID
            AND
                   xmlID IN (SELECT DISTINCT xmlID FROM ElementValueInfo
                   WHERE dataValue  = "Paula" )
            AND    xmlID IN (SELECT DISTINCT xmlID FROM ElementValueInfo
                   WHERE dataValue  =  "Jones" )
```

An example of a search qualified with element names is:

Student.Name.First = "Paula" AND Student.Name.Last = "Jones"

This is translated into the following three SQL statements:

```
SELECT DISTINCT elementID1 from ExpandedElementInfo
Where elementName = "Student.Name.First"

SELECT DISTINCT elementID2 from ExpandedElementInfo
Where elementName =  "Student.Name.Last"

SELECT DISTINCT   xmlID
FROM        ElementValueInfo
WHERE
                  xmlID IN (SELECT DISTINCT xmlID FROM ElementValueInfo
                  WHERE (Expanded Element ID  =  elementID1  AND  value =
                  "Paula") )
            AND   xmlID IN (SELECT DISTINCT xmlID FROM ElementValueInfo
                  WHERE (Expanded Element ID  =  elementID2  AND  value  =
                  "Jones"))
```

Other Query Functionality

The query language available to the user includes the following functionality:

1) Wild cards in the element names. Therefore it is possible to write searches such as:

   %First = "Paula" AND %Last = "Jones"

   This query will look for the first element name in the DTD ending in "First" and the first element name ending in "Last" and then perform the metadata search as previously explained. Thus this search returns identical values to that returned in the previous example.

2) Partial matches in the data values. Thus the user can enter:

   %First CONTAINS "Paul" AND %Last CONTAINS "Jone"

   Again this search returns identical results to that returned in the previous example.

3) The following Boolean operators are supported: AND, OR
4) The following comparison operations are supported: <> = < > <= >= CONTAINS
5) All results are returned in XML format.
6) The user can request any or all of the elements from the DTD schema and the Search Manager reconstruct either the entire XML document or fragments of the XML document. Again the user can use wild cards to indicate which elements are to be returned.

Results of the XML to relational mapping

Storing XML metadata in a RDBMS yielded mixed results. One the positive side the Broker is able to store any XML document no matter what the DTD schema, which is very flexible and therefore desirable. The inbound user query is mapped to SQL in order to perform the search which saved much development effort. It also enables the middle tier to provide a powerful non DTD specific interface to the Web Client which in turn enables the Web Client to offer an interface based upon the domain (DTD) that the users is interested in not just a LOM specific interface. Further a Relational database is a secure repository, which can be accessible by other applications. On the negative side standard SQL text searching is limited and needs to be augmented to provide such functionality as stemming, a Thesaurus, etc. This could be achieved using something like Oracles ConText product or by alternatively by developing similar functional as a front end to the database. Due to time constraints neither of these was attempted during the project. The trail produced adequate performance results for a database of 137 metadata documents, more development and testing is being done before the performance issue can be said to be fully satisfied for a large-scale repository. There are some fundamental mismatches between XML and the relational model these are:

1. XML has no limit on element length, Relational databases do for elements which can be indexed. For the trail an maximum element length was assumed.
2. XML is hierarchical and permits a element to repeat. Relational databases do not permit repeating elements and their main structure is a table not a hierarchy. The XML must be represented in a number of SQL tables and the resulting queries are complex as they must span these tables.
3. XML only supports the data type text it does not support such simple types as integer, date, currency etc. This leads to problems when comparing numeric and date elements e.g. "3" will compare greater than "100" which is clearly not what is expected. The only way to solve this problem is to parse the XML and attempt to recognise the type of a given element. This was not done as part of our trial and it is not expected that this would be an easy problem to solve in a generic fashion.

Observations from the trial

These observations come from the authors experience of developing the Broker software and a comparison against their expectations and previous software development experience. The observations are also as a result of the operation of the broker in the GESTALT project. From a software engineering stand point it was noticed that the functionality of CORBA and XML overlap in that they can both be used to describe the messages passed between different parts of the system. In one respect this can be seen as an advantage as most of the application specific information is in the metadata and this is the data most likely to change, leaving the more stable parameters in the IDL bindings, which should not change significantly over time. From another perspective, however, it would have been possible to implement the broker with say JAVA Remote Method Invocation and XML based messages.

As part of the demonstration different European partners kindly contributed approximately 137 LOM format metadata files on different programming and networking courses. During the trial a number of cases were demonstrated showing metadata searches returning fewer matches than Internet searches. For example suppose a student was looking for a "C++" programming course. If an Internet search was done for the string "C++", it would return thirty matches. If a metadata search was performed using the Keyword element i.e. keyword = "C++" 5 matches would be returned. Finally a compound metadata search could be performed for an Italian-speaking student and would return 2 matches. The principal behind these searches intuitively makes sense, since if the keyword element is set to "C++" the course is likely to be about "C++", whereas "C++" can be present in other parts of the metadata but the course would NOT necessarily be about "C++".

The LOM metadata was not filled in a complete fashion, people filled in different elements in the LOM, and the same elements differently. Also authors reported that it took some considerable time to understand the schema, and stated that they would have appreciated a LOM specific tool to assist them. A further difficulty was that much of the LOM was of little use for resource discovery since much of it is used for the delivery of a resource. Finally casual user's performing a search did not find the LOM structure easy to navigate. This experience points to some "profile" (subset) of the LOM being agreed for resource discovery. The Dublin Core initiative on Education metadata was not complete at the time of the trial and it would be most interesting to contrast these results with a trail of Dublin Core.

The Broker is highly dependant on the DTD schema, as GESTALT's experience with LOM shows. As far as resource discovery, for a mass audience of casual users, a straightforward DTD schema will make it easy for course authors to create the metadata and easy for students to understand and navigate whilst searching. A complex structure will make it difficult for authors to create the metadata unless they are given a specific tool and even then they will have difficulty if they are required to enter too many fields or do not understand what values a given field requires. Further a complex structure will make it hard for users to query unless some subset of the metadata is identified. It is not possible to define precisely what is meant by a straightforward DTD schema, some guidelines are:

1. A few required elements and attributes, let say less than thirty.
2. A clear definition of each element with examples, including its data type (integer, date, etc).
3. The use of attribute lists (pick lists) or fields with a limited number of values, were possible e.g. the names of all the collages in Ireland.

Conclusions

The trail found that a metadata driven Resource Discovery Service is possible and more importantly that it can provide a more accurate search facility than today's search engines given a straightforward DTD schema (see previous paragraph for a definition of "straightforward"). However course authors must put in extra work to generate the metadata according to a standard schema(s). The LOM is a good beginning for the Educational domain however it is possible that a subset of the LOM should be defined for Resource discovery and that other Educational metadata schemas will emerge e.g. Dublin Core. In order to gain acceptance these schemas should have a straightforward design for the benefit of the course authors who must create the metadata and perspective students who must search the metadata. A new project funded under the IST European Research Program EASEL, is continuing the metadata approach for content searching and management. EASEL is building on the metadata specification and is extending these to support adaptive content and retrieval

A relational database can be designed to store any XML document. However querying that database is limited from the perspective of performance, and is certainly limited from the perspective of standard text searching feature such as stemming, Thesaurus etc. The authors are currently researching improvements to the initial design to overcome these limitations for very large-scale metadata repositories.

There are no fundamental design issues with respect to the Broker, which are outside what can be achieved by software engineering, with the proviso that no work was done to map between different metadata schemas, since only one Educational Schema was available to us. However a significant amount of engineering and other work still needs to be done to make a metadata driven approach a reality.

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CoFIND: steps towards a self-organising learning environment

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Abstract: This paper reports on the ongoing development of CoFIND (Collaborative Filter in N Dimensions), a web-based system designed to form the basis of a self-organising learning environment, where individual acts of learners combine to organise a coherent system of relevant learning resources and experiences. We start by attempting to analyse the ways in which existing web-based systems might provide this support. We then consider how a group of learners whose learning environment is mediated through CoFIND can better manage their learning and become their own teachers. CoFIND is based around explicit exposure of metadata, making the learning needs of the learners visible through a process of establishing the qualities that they seek in a resource, rather than simply the facts that they seek to learn. This system organises itself through a combination of speciation, ordering and extinction that is in many ways akin to the process of evolution. The paper does not present experimental evidence but is concerned with describing the system and its theoretical underpinnings.

Context

Educational systems, web-based or otherwise are (on the whole) complex systems and thus evolve. As Brad Cox writes, "what actually governs complex systems is rarely the industrial age's notion of design at all. Rather, they *evolve*, shaped by an interaction in which system and environment minutely adjust to each other as biological organisms evolve within ecologies " (Cox 1997). Unfortunately, the forces that drive this evolution are not always the needs of the learners, but may be swayed by everything in their environment from government policies to a University's traditions. The Web has the potential to free us from many of these forces and discover new ways of lifelong learning, liberated from the traditional ties of lectures, classrooms and institutions that evolved in an age where they were the fittest solutions. We are seeking ways of creating self-organising adaptive virtual learning environments by actively promoting competition and selection pressure, so that education consumers collaboratively generate a better educational experience for themselves.

The roles of the teacher

Teachers have a variety of roles in a conventional educational system. Amongst other things they provide emotional support, source materials, scheduling and so on. However, based on our experience as teachers, we have concentrated on the following key roles: to provide expert help, a guided path through new materials and resources, inspiration and motivation, feedback and assessment, and to establish the boundaries of the subject .

Self-directed management of learning using web-based and other Internet technologies

There are many resources available on the Internet that may either explicitly or implicitly help learners address almost any topic. We start by looking at some ways that are already available to match the roles we have identified for a teacher.

Expert help

The Web and other Internet-based mechanisms such as mailing lists and newsgroups can be a useful source of help. A search through Deja.com (Deja, 1999) or a similar interface to discussion groups will often reveal answers to questions, sources of expertise and a means of exploring a topic through discourse. However, users of such a system must know how to frame the question and understand the answer given. Such a level of understanding may be too great for beginners in a subject, and much time can be wasted posing irrelevant questions or questions at the wrong level. Even after overcoming these obstacles the correct question may lead to the wrong answer as we may know little of the credentials of the expert whose assistance we seek. Solutions such as the collaborative filtering reputation brokering system proposed by Chernenko (Chernenko 1997) could be of some assistance here, as could a vetted list of trusted experts as used by AGORA21 (Zellouf et al, 1999). An associated issue with most threaded discussion mechanisms is the problem of losing the thread. A large group of messages displayed hierarchically becomes difficult to navigate. Although sites such as Deja.com can help through providing a search mechanism it can still be difficult to follow appropriate threads at an appropriate level. Some of the most promising work in this area comes from researchers in Computer Supported Collaborative Argumentation as exemplified in the D3E system used in the Journal of Interactive Media in Education (JIME, 1999), where metadata is provided with the message indicating where it lies in relation to other messages (agree, disagree or neutral). Similar results are achieved by systems exemplified by GroupLens (Resnick 1997) that apply collaborative filtering technology to help identify interesting threads. Promising though such technologies are they do not fully address the changing needs of learners as they assume a slow-moving or static range of needs. Learning is about change and our needs of yesterday do not necessarily match those of today. Another approach is applied by Ackerman in his use of Answer Gardens (Ackerman & McDonald, 1996), where possible answers to questions are suggested by the computer and, should these answers be deemed unsuitable, the user presses an "I'm not happy" button to elicit further help from a human expert, whose reply is then added to the database of answers. This is an effective self-organising technique, although it relies upon the presence of a known group of experts within a subject area. If one of the things that we are seeking is such a known group of experts then the system might not help us.

A guided path

Knowing where to begin and where to seek information at an appropriate level as our needs develop is central to beginning to learn about a subject. Finding information on the web for any given topic is usually not too difficult, but identifying what is relevant or appropriate is much harder. Systems such as PICS (Resnick 1997) or IMS metadata (IMS, 2000) may help in the future but are not yet sufficiently widely implemented and rely on authors', not users' classifications. Another route is provided by Walden's Path (Walden's Path, 2000) which allows its users to create paths through web pages for other users. However, there are many potential paths to learning the same thing, some of which will be more or less suitable for a given learner. Also, as learners our needs are dynamic and the path on which we started may not be the same as the path towards our final goal.

Inspiration and motivation

There are many reasons that we are inspired or motivated to learn. Inspiring teachers help to encourage intrinsic motivation and also manage some aspects of extrinsic motivation such as applying pressure, setting tests and so on. It is also helpful to be guided by those who know why we must pass through grey and dull areas before reaching the goals we seek. Although the web provides hyperlinks to guide us, these tend to embody a particular perspective which may or may not match our own. We may easily become lost in hyperspace, following links that may not be relevant to our needs. Adaptive hypertext (Brusilovsky 1996) is effective, but only looks at the single qualitative dimension of prior knowledge to decide on the content provided. If we seek inspiration then we seek more qualities in a resource than that we have enough knowledge to understand it.

Feedback and assessment

A critical part of learning is knowing *that* you have learnt. Web-based systems that may help us to achieve this include CASTLE (CASTLE, 1999), Hot Potatoes (Hot Potatoes, 1999) and any number of commercial systems best exemplified by Question Mark (Question Mark, 1999) that provide a mechanism for producing multiple choice and other fixed-answer questions. Sometimes we may take advantage of discussion mechanisms (mailing lists, newsgroups and so on) to play with ideas and get feedback. If we are willing to pay for it, we may even go for a full distance-learning course and get tutor feedback. There are mechanisms that provide feedback to non-formalised questions based on lexical semantic techniques, some of which give fairly accurate grades but none of which give particularly meaningful feedback (Whittington & Hunt, 1999). Systems such as Self-Assessed Free Text (Kjöllerström & Mårtensson 1999) provide a model answer for comparison with the student's own answer, a possible route forwards for a limited range of assessable outcomes.

Establishing the boundaries

As well as establishing a path, it is important to know the boundaries of that path and when you have left it. On the web, the problem is seldom the paucity of information. Instead, the information must be filtered to fit it to our current learning needs. When we learn to read we do not necessarily need to know about iambic pentameters. There are many courses available on the web that provide topics and subject references, providing clear guidance on what lies inside and outside of a subject. However, despite broad consensus in most subject areas there are often variations between one expert and another as to the boundaries of a given subject, and it can be difficult to choose an appropriate course from the many that are available.

About CoFIND

CoFIND has grown since it was first presented at WebNet 99 (Dron et al, 1999). It is a web-based system written using Microsoft's Active Server Pages which is intended to support relatively small focussed groups of motivated undergraduate and postgraduate students with common learning goals. It has been developed to demonstrate methods of self-organising the combined individual actions of its users into a coherent and meaningful learning environment. It starts with the premise that the web provides very effective means of communication and publication, as well as an extremely rich source of learning resources, but that it must be tamed to be of use to learners.

At CoFIND's heart is a collaborative bookmarking system where bookmarks added by its users not only point to web-based resources but also to anything that may be of use to learners, from books to films to people and places. Metadata (known as *qualities*) are supplied by its users to share opinions about resources with others. Resources are classified by the users into one or more topics.

CoFIND is able to originate resources, through a threaded discussion forum, the ability to upload files and a forms-based option to publish simple web pages. Like other resources, these can be made available to other users, who may also rate them according to qualities and categorise them into topics.

To assist with filtering resources, CoFIND incorporates a simple filtering search engine.

About qualities

Qualities identify and describe what users value in a resource. Ratings may be given to resources according to how well they match selected qualities. Resources are displayed in a list in which they move up and down according to an algorithm based on their average rating for selected qualities and the number of times they have been so rated. Thus, a given resource may be at the top of the list for a quality of "detailed" but at the bottom for a quality of "simple to understand".

Users may add any number of qualities to the system but to keep them relevant to the group, qualities evolve in competition with other qualities. Those that are not used fall to the bottom and eventually die of vote starvation. Further selection pressure is applied by only allowing the selection of a single quality at a time, thus forcing the users to make choices about which are valuable to them. Successful qualities are those which provide useful lists of resources. This feedback mechanism creates a self-organised list of qualities that adapt to their users. For a system to be self-organising it is equally important that too much change is discouraged as too little. An excess of change leads to chaos, where no species can develop as the rules and environment change too whereas too much stability results in unremitting stasis, without movement or improvement. Based loosely on the work of Kauffmann and others, CoFIND's list of qualities is tuned to self-organise by hovering on the edge of chaos (Kauffman , 1996).

About topics

Topics are to do with subject matter rather than what is valuable about a resource. A resource may be categorised as belonging to more than one topic. The role of the topic in CoFIND is much the same as the role of a topic within a conventional course, providing an indication of the subject matter. Topics may be entered by the users into a hierarchy of other topics.

CoFIND as an enabler of self-organised learning

CoFIND can fulfil some of the roles a teacher, although it does not necessarily exclude the teacher from the proceedings. Therefore, we now revisit our minimal requirements for a teacher to see how CoFIND could provide an alternative.

Expert help

CoFIND provides a mechanism to find the help we need in the form of resources. When learners find resources that help them to solve problems or understand issues these are added to CoFIND. As any resource (web-based or otherwise) may be entered onto the system, not only are web pages made available, so too are references to (for example) experts, books, museums, TV programs and films. Qualities help to establish the level and kind of help that is sought whilst topics provide the areas of interest. Through sharing, rating and categorising resources learners communicate and construct knowledge and understanding.

CoFIND's discussion mechanism provides a means for direct questions to be asked and answered by other users of the system, to the benefit of the questioner and the replier. The mechanism differs from conventional threaded discussion groups as the value and relevance of such conversations can be discovered through the process of quality rating.

A guided path through new materials and resources

Through the process of rating and the provision of qualities learners are able to identify relevant resources that fit their particular needs at each stage of the educational process. We know that they are relevant because they have been considered so by other learners with similar needs and wishes. Guidance is thus born collectively through interaction with the system. Different learners will discover different aspects of a subject and their combined efforts will structure that information into a whole which others with similar needs can follow. Currently this provides less of a path than a model of the current context, but future versions of CoFIND will allow collaborative linking of resources in the manner of Walden's Paths, creating a structured path to follow.

Inspiration and motivation

CoFIND can help and motivate users in at least three related ways:

1. It can provide a range of resources that are more relevant and appropriate to learn from than would be provided by conventional search systems and directories, avoiding less useful resources and thus making learning a more pleasurable experience. As with all pleasurable experiences, there is an incentive to get more of the same.
2. It provides a means to communicate with other users and to benefit from their experiences. The act of participating in a learning community provides greater motivation than working alone, helping to

reduce one of the demotivational pressures identified by Herzberg, that of isolation. (Herzberg 1966)

3. Feedback and assessment can provide motivation through positive reinforcement. The ability to discuss and publish combined with a feedback mechanism that gives a fairly precise and anonymous evaluation of what is discussed and published may provide senses of what Maslow describes as belongingness and esteem (Maslow 1954). Of course there is always the danger that the opposite may occur. CoFIND does not embody tact.

Feedback and assessment

By allowing users to upload pages and enter free text resources as well as providing a means of making web-based resources available, CoFIND lets work be shared. Qualities provide the criteria for a collaborative assessment system, generated by the combined requirements of the learners themselves. Anonymous and collaborative quality ratings provide an evaluation mechanism, where the combined critical understanding of the users of the system can be brought to bear on any resource. Individual variations in understanding are evened out as they combine with others. The ability to discuss issues surrounding a resource allows subtler personal evaluations and critiques if required, more in keeping with traditional assessment methods. This mechanism is most suited to small groups where a personal seal of approval from a known fellow-user will count for more than that of a stranger.

Establishing the boundaries

Few are better qualified than an individual learner to recognise what is and is not useful at a given stage of that learner's development. The fact that the available qualities have evolved to be the most commonly used means that resources rated by them are more likely to be relevant. As an increasing number of resources become available and the selection of those resources is honed by the appropriate use of qualities and classification into topics, so the limits of a given subject become more firmly established. The boundaries of the topic appear by an evolving consensus rather than an individual expert's opinion. However, CoFIND does not seek to completely replace the teacher in this role. Someone has to produce the resources that users can start from, to provide the content with which the learner interacts. CoFIND is there to help the user decide which of many resources are best, to identify the best teacher.

Some outstanding problems

CoFIND is targeted at groups of learners with shared learning objectives and assumes that a particular cohort will be using it. As with traditional forms of teaching the learning material may be difficult to follow and irrelevant to latecomers, the range of available qualities having adapted to a particular group, not the latecomer.
On the web, resources go away and also change. A reference that was useful yesterday may be useless or positively harmful today. For example, it is a good thing that learners may post work to CoFIND then change it completely in response to quality ratings. This means that there is a time-lag between a resource changing and the accompanying ratings changing too. We are therefore considering the provision of an ageing mechanism for resources and quality ratings, to ensure that they remain constantly fresh.
Providing the incentive to participate and making that participation easy, transparent or desirable has to be a key goal for any future developments. Until sufficient resources have been entered, CoFIND is useless and there is little incentive to use it. We continue to improve the interface and usability but we are still seeking ways of kick-starting the system.

Conclusions

Embodying evolutionary principles, CoFIND is itself an evolving system, a snapshot of which is captured in this paper. Based on feedback and experience with users we are adapting it constantly to allow it to better suit the needs of learners.
At the time of writing, students from a variety of cohorts in a number of circumstances, ranging from those

studying network management at masters level to under-graduates assessing each others' work to a group of HCI students rating various web sites according to their own generated criteria are testing the system and providing us with feedback.

One of the most interesting outcomes so far has been a clue as to what learners seek in learning resources. Collecting such metadata may yet prove to be the most useful function of this tool, particularly if it can be used by a wider audience than the small experimental groups it has so far been tested on.

We are still some way off providing a perfect environment that develops ecological niches to suit all of its users. As we incorporate subtler relationships between qualities, resources and topics so we expect to see the unexpected emergent behaviour, for patterns and 'courses' to develop that could not have been foreseen. From these vague beginnings we can perhaps see a glimmer of how an organisational intelligence, distinct from yet composed of the minds that form it will provide a new way of amplifying our understanding of the complex world in which we live.

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Collaborative Parallel Prototyping for Web Site Design Using PICTIVE

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Abstract: The paper describes the development of an organisational Web site through a collaborative design process. The design process applied the PICTIVE technique for low-tech prototyping in an innovative manner to open-up the design space and create a number of alternative 'look and feels' for the Web site. The different prototypes were then evaluated. The paper reflects on questions of user acceptance, information sharing and collaborative design on the development of organisational Web sites.

Introduction

This paper describes the progress of an on-going collaborative design activity for an organisational Web site. The context for the design was a University Computing department where the community had a high level of expertise but where the prevailing work style was individualistic and staff in the department were geographically widely dispersed. As a result the departmental Web site had evolved in a completely unstructured and haphazard manner. Within the department there were groups with extensive expertise in Web design, HCI, interface design and object oriented design. However, despite or perhaps because of this, different research groups had developed Web pages with completely different 'look and feel' and navigational properties. Some staff felt that this had resulted in a site with poor usability that provided a poor external image to perspective students and staff. Therefore we embarked on a redesign of the Web site that was tightly constrained in terms of money and time, although there was a good deal of in-house expertise which could contribute to the design of a new site. Since the Web site would need to reflect and include contributions from most members of staff we considered the project to be an excellent candidate for collaborative design.

In order to explore the issues of collaborative Web design during the course of this activity we proceeded on an active research basis to investigate the progress of the redesign as an opportunity to contribute answers to a number of questions:

- How is information used in collaborative design?
- Does collaborative design encourage participation and help to sustain interest and acceptance of the design product?
- What kind of information is shared in the same community and how is it best represented?
- How can the design space be opened up in collaborative design?

A major objective of prototyping is eliciting user requirements. This can be particularly difficult in the case of Web sites which typically are accessed remotely. Secondly, web sites are often designed and built in an evolutionary fashion. In evolutionary prototyping, the user interface tends to be expanded rather than thrown away, consequently decisions taken early on can influence the final design. Therefore we need a way to open up the design space for the web site if we are going to avoid constraining its final design.

The redesign was planned to consist of the following stages:

1. expert evaluation by external HCI experts,
2. collaborative parallel prototyping using PICTIVE,
3. comparative evaluation of alternative designs,
4. prototype Web site development, and
5. evaluation of the prototypes.

Expert Evaluation

Previous work (Smith & Dunckley 1999) had led us to conclude that designers engaged in collaborative design can be highly motivated by users' comments. Since, in the case of Web design, it is difficult to identify typical user groups, we modified the procedure to replace the users with external HCI experts. This activity was carried out by providing a small group of external HCI experts with electronic forms and by asking them to assess the existing Web site remotely in terms of three simple task scenarios. The experts were asked to assess the site in terms of visual impression, navigation, consistency, predictability and its appropriateness for different user groups. Their responses highlighted a number of problems, particularly navigation (getting stuck in dead-ends, difficulty in locating information, broken links, no way back to home), poor visual impression and readability, and lack of consistency. They concluded that even expert Web users would struggle with the web site and that users with mild disabilities and learning difficulties would fail to complete their tasks. A particular feature of the existing site was hyperlinks to collaborative institutions, individual's sites remote from the organisation and sites staff members considered interesting. This made the navigation of the departmental site particularly difficult for the user to comprehend. The experts' views were grouped under related issues but their actual comments were provided to designers in the collaborative stage.

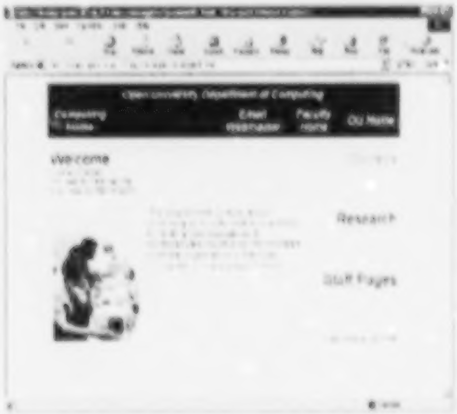

Figure 1: Web site prototype developed by an HCI expert.

In order to compare the effectiveness of the collaborative design with the results of a single designer we obtained a new 'look and feel' that was created by an HCI expert based on both the results of the expert evaluation and Web design guidelines (Fig. 1). The result could be described as a 'simple horizontal bar menu' which focused mainly on improving the navigational aspects of the site. This was created before the collaborative design exercise and was evaluated in the same way as the other designs.

We wished to employ collaborative design methods because it was hoped that this would enable us to tap staff expertise, gain greater acceptance and commitment to the design and generate commitment to help with site maintenance. It was recognised that only by participation of staff in the site, could the research groups and individual staff pages be kept up-to-date, dynamic and interesting. The design of a new 'look and feel' was achieved through a modification of the PICTIVE design technique. PICTIVE (Muller 1992) considers the detail of design, what the user does and what he or she uses to do it. That is, the 'how' and 'when' questions. The origins of PICTIVE arise from both the Scandinavian workplace democracy movement and practices from the low-technology prototyping tradition. The attraction of PICTIVE was that it would allow the design team to create and rearrange low-tech representations and to develop scenarios for use. The PICTIVE technique uses familiar office-materials, for example coloured pens, Post-It notes, highlighters, coloured paper and tape optionally supplemented by customised materials. In this case to provide a template for the design, we provided large sheets of paper with Web browser windows printed on them.

No application of PICTIVE to Web design has been reported and the design of a Web site does not focus on the kind of work practice scenarios that PICTIVE was designed to explore. With remote users it is difficult for Web designers to predict or envisage what use will be made of a Web site. We had envisaged that typical users would be seeking information about computer courses, research topics and staff expertise but the browsing behaviour of Web users is notoriously difficult to track and understand. It was hoped that the plasticity of the low-tech representations - that is the ease with which the participants can change them - would help the team break out of unsuccessful designs and create some original 'look and feel's. A special situation of our collaborative design was that all the participants had a high degree of knowledge of some area of computing, either in theory or practice, but knowledge specific to Web design was restricted to a few. Most of the participants knew the Web as users only. The participants were drawn voluntarily from the lecturing staff, research students, project software designers and programmers, and technical support staff in the department. We felt that these represented the stakeholders in the site, embodied diverse expertise and would capture the commitment of all those parties who could influence the success of the Web site.

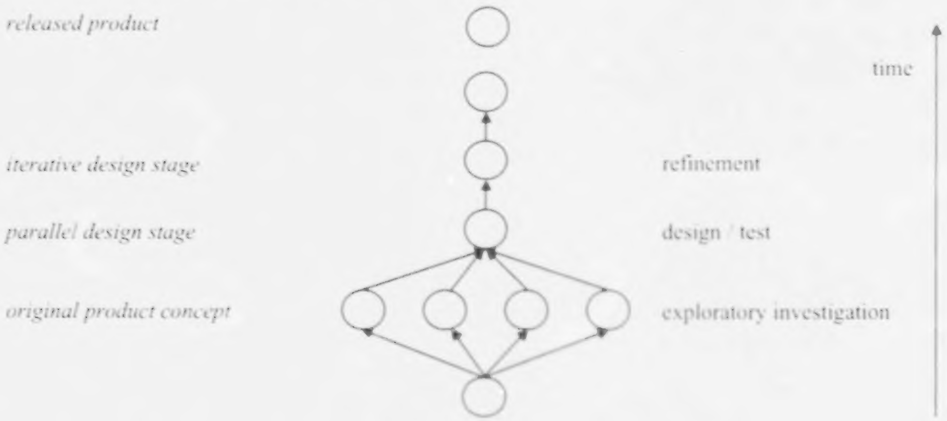

Figure 2: Parallel prototyping in user interface design.

According to Muller *et al.* (1995), published descriptions of participatory design methods have tended to be broad and allusory, rather than well specified since these practices can be viewed as evolving, socially-constructed practices. However there is a need to know certain methodological information such as 'what exactly was done', can the reader repeat the method, and are the results creditable? Hix *et al.* (1994) have noted that it is difficult to integrate usability-oriented methods into software lifecycle practices unless the methods are specified in a language that is accessible to software engineers. In our use of the PICTIVE method we introduced several changes to the original technique. We adapted the PICTIVE method described by Muller *et al.* (1995) to address the problem of designing systems for remote users such as Web sites. In addition we wished to be able to open out the design possibilities by having several design groups generating ideas as part of a parallel prototyping strategy (as shown in Fig. 2) where ideas from several different prototypes can contribute to the design.

Although departmental staff would be substituting for users it was not clear what information would be most effective in supporting the design activity. All members of the groups were known to each other, as well as the expertise they brought and their status within the department. The design exercises began with a mini-tutorial to explain the purpose and structure of the PICTIVE technique and to explain how the session would be conducted. In order to address the questions listed above we set up three PICTIVE design groups which were each provided with the same PICTIVE materials, but were given different sets of information as follows:

- Group U - the HCI experts' actual comments.
- Group G - a summary of Web design guidelines.
- Group A - the HCI experts' evaluation and summary of Web design guidelines.

The Web design guidelines were brief summaries of recommendations drawn from Fisher (1997), Lynch & Horton (1999), Marcus (1999), Neilsen (2000) and Taylor (1998). We attempted to ensure that each group contained the same balance of expertise and that every group included someone with Web design expertise. All participants were asked to complete a short evaluation form about the collaborative design activity at the end of the design session. The groups were also videotaped as part of the normal PICTIVE process. They responded differently to the collaborative design situation and the information and materials provided to them.

Group U (who had the expert evaluation information but no design guidelines) spent a great deal of time pooling their knowledge of Web design, discussing design options, information content and structure, with little interaction with the PICTIVE materials. This group reported the least satisfaction with the PICTIVE design activity. In contrast, Group G, who were missing the experts' evaluation information, spent most of their time speculating on the types of users, what the users might want to do and the users' perspectives. After being nagged by the organiser they eventually made the most use of the PICTIVE materials of any group, with all members of the group contributing equally. This group reported the most satisfaction with the PICTIVE design activity. Group A complained about the volume of information provided which they considered to be too much to absorb and a distraction. However they made moderate use of the PICTIVE materials, annotated extensively with pen comments. This group focused on navigation and structure. This group reported intermediate satisfaction with the PICTIVE design activity.

It is an essential part of the original PICTIVE technique that ideas be developed and explicated in concrete terms, usually by using low-tech materials to represent detailed layout and behaviour of the interface. However this can leave a rather confused set of material on which to base the design of a software prototype. Muller *et al.* (1995) recommended that a closing walkthrough of the product of the design session should be videotaped to provide a multimedia design document. In our case all groups reported a dislike of being videotaped during the design process. We had videotaped the whole sessions of the groups sequentially and interleaved.

The output of the PICTIVE sessions was converted to a set of software prototype Web sites with a few pages linked to give both the 'look and feel' and the navigational style suggested by each group. The paper and video records of the PICTIVE sessions formed the basis of these designs but since these were going to be produced by a contracted Web designer a hierarchical State Transition Network (STN) was produced for each design (Dix *et al.* 1998). These were particularly suitable for the Web site interaction documentation since the interaction objects are basically just simple links. It was easy to generate the STNs for the groups who had made extensive use of the PICTIVE materials. For the group who had not interacted with the materials a design was formulated using the videotaped comments of the group members. The PICTIVE design sessions facilitated the creation of very contrasting designs (as presented in Fig. 3) that were quite different from the design produced by the HCI expert. Therefore this process provided four different designs for consideration.

Comparative Evaluation of Alternative Designs

The prototypes were evaluated by distributing a brief electronic questionnaire to all stakeholders, seeking their views of the prototypes which were made available in interactive forms. Informal feedback and opinions on the prototypes was obtained while developing the prototypes, particularly from those who had participated in the PICTIVE design exercise. Although they were invited to do so, these people did not return their questionnaires, presumably because they felt that they had already contributed their opinions on re-design of the Web site.

The number of questionnaires returned precluded a detailed statistical analysis of the results. However, the table-based system was preferred over the horizontal bar and index card based systems, with the frame-based system lagging some way behind. It is possible that these preferences were influenced by the way in which the prototypes were implemented. All our evaluators had a high degree of knowledge of some aspect of computing and were experienced users of the Web, although specific Web design skills were restricted to a few. In evaluating the prototypes, our stakeholders will have applied whatever Web design skills and opinions they held, including the widely held opinion that 'frames are bad', no matter how well they are used. These and other aspects of the way in which the prototypes were realised could potentially have biased the results.

Clearly there is more work to be done on evaluating the prototypes. In addition to repeating the evaluation with a larger cross-section of the anticipated audience for the web site, we have not yet carried out an heuristic evaluation of the prototypes, nor have we evaluated it using performance metrics.

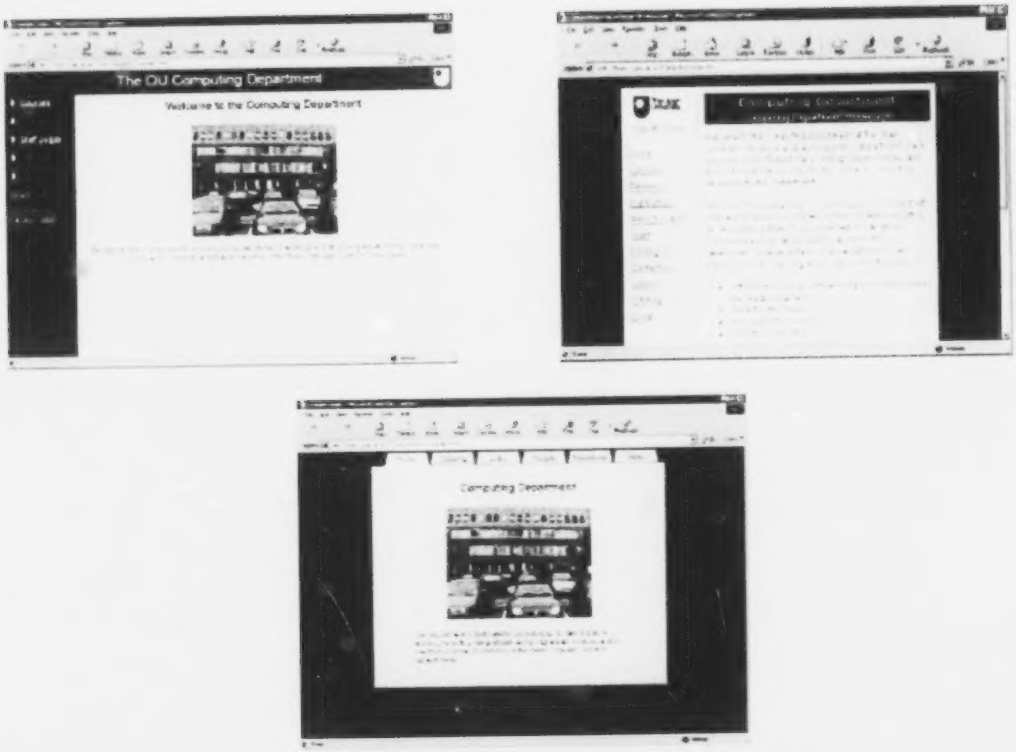
The OU Computing Department
Welcome to the Computing Department
Computing Department

Figure 3: Prototype Web designs. **(top left)** Frame-based system with expanding menus. This design splits the screen vertically and horizontally and provides a right-hand vertical menu grouped around the themes – courses, research and staff. This design was the subject of some controversy among members of the department with HCI experience who were against the use of frames. **(top right)** Table-based system. This design provided a similar 'look and feel' to the frame-based system without using frames and in a simpler style. The content of the left-hand cells presented a menu which was similar to the frame-based design. **(bottom)** Card-index-based system. This design was the most radical, consisting of a set of stacked pages with index tabs as the menu system. It was strongly advocated by its designers. While visually attractive it suffered from the disadvantage that it was difficult to combine with a normal vertical scrolling style and did not use space efficiently.

Discussion and Conclusions

Both software engineering and HCI approaches have to a large extent converged in a mutual recognition that participative design (which captures the context of use) has a key contribution to make to distributed information systems. Object-oriented approaches such as the Unified Modelling Language (UML) include the concepts of use cases and scenarios. However these distributed systems can make it difficult to engage their users in the development process. It can even be difficult to identify typical users and their tasks.

We concluded that the parallel prototyping form of PICTIVE was successful and an effective use of resources for generating alternative designs. The provision of supporting background materials is crucial for the success of the design sessions. The groups needed both user comments and design guidelines but these must be distributed to all participants prior to the design sessions. The social aspects of the groups need managing and a facilitator needs to be present to keep groups on track to meet their objectives. PICTIVE has its origin in Scandinavian culture and in translating it to the United Kingdom it was noticeable that cultural factors such as power-distance and uncertainty avoidance influenced group effectiveness (Hofstede 1991). Participants who were very conscious of their status versus the rest of the group did not contribute as effectively. In addition the toy-like nature of the PICTIVE materials will not appeal to all and some participants were clearly more at home with more formal design techniques. The UK culture is also fairly individualistic, which can add to group work problems. We found that it was necessary to transform the PICTIVE designs into more formal representations in order to realise the designs as software prototypes. This was sensitive to the skills of the HCI/software designers. All the participants expressed some opposition to videotaping the whole of the sessions and we would recommend that videotaping should be restricted to walking through the final outcome of the session when it can be of most use as a video document.

In summary, we have described the application of the PICTIVE technique to Web design. After analysing the outcomes we would recommend the following procedure/process model should be adopted for Parallel PICTIVE Web design (Tab. 1). Generating the three prototype Web styles was not resource intensive. It provided a means of opening out the design space and allowing the views of many members of staff to be expressed. The method offered real alternatives from which to arrive at a consensus and allowed elements from each prototype to be incorporated into the redesigned Web site.

Stage	Action
1	Participant selection based on • personal and organisational stakes in the project • anticipated contribution and expertise
2	Preparation and distribution of supporting materials to participants • user comments and requirements • task/use scenarios • design guidelines/options
3	Mini-tutorials including demonstrating the outcome of a previous PICTIVE session
4	Preparation of PICTIVE sessions, selections of balanced working groups, facilitators, PICTIVE materials and any customised materials
5	PICTIVE sessions with videotaped walkthroughs
6	Parallel PICTIVE outcomes described by a more formal specification method

Table 1: Recommended procedure for the application of the PICTIVE technique to Web site design.

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Extending IOS's Collaboration via Web-Enabled Whiteboards

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Abstract: The purpose of this paper is to discuss the development of a web-based asynchronous whiteboard system used as part of an online collaborative system. The whiteboard system has been designed to perform in a manner similar to that of threaded newsgroup systems; users can post new whiteboard messages and reply to others via a content layering mechanism. As part of the whiteboard's development, we needed an easy to use method for both storing whiteboard content and defining the relationships between layers used in a reply. In order to accommodate these needs, we decided to use the Extensible Markup Language (XML) (World Wide Web Consortium 99). Using XML, we were able to define a language capable of expressing both content and relationships within the whiteboard application. This paper explains the need for the whiteboard system within our online collaborative system, the functionality of the whiteboard, and design choices pertaining to the implementation. The paper also examines initial assessment and additional evaluation plans for the whiteboard system.

Introduction

The Integrated Online Seminar System (IOS), formerly known as the Course Submission System (Flanagan 98) was designed to address courseware needs for students participating in multimedia design classes.

The IOS system provided two basic functions. First, the system allowed students to submit multimedia content via a web-based graphical interface. The graphical interface was designed to be easy to use while still being flexible enough to allow advanced users to submit complex collections of files. Postings were cataloged for the instructor and the content of the submission was placed in an easy to find location within IOS's web application structure. This structure made it possible for students to quickly find and view their peers' submissions. It also provided a higher degree of consistency and familiarity for the students.

Secondly, IOS provided collaborative mechanisms by which students could critique and respond to each other's work. IOS's framework allows student's comments to be bound to the media, providing a connection between the content and the conversation. This linkage helped to ensure that the focus of collaboration remained on the media, and not on the textual reply. Throughout IOS's development, the design philosophy has been to emphasize the collaborative focus on the media instead of the text.

Over the last five semesters, we have used the IOS system in within digital media courses. Although we found that the IOS model helped foster collaboration, our assessment testing (Flanagan 99) also showed the need for better graphical tools to assist the collaboration process. In order to address this need, we decided to add a web-based whiteboard system to IOS. At first, we examined several synchronous solutions to the problem, but found that they had similar problems to that of synchronous chat systems. Instead, we decided to build our own. The remainder of this paper examines the construction of the whiteboard system, including its components, design, user-interaction model and its interaction with our web-based server technology.

IOS Whiteboard

When we first started the construction of the whiteboard, we had several design conditions to contend with. Our primary concern was that the whiteboard system integrated with IOS as a whole, and did not become a stand-alone function of the system. We also wanted to ensure that the operation of the whiteboard was analogous to the operation of the critique and comment process already in existence within IOS. We decided to construct an asynchronous whiteboard system based on a threaded newsgroup model. In our design, we wanted the students to have the flexibility to either create an original message incorporating parts of the submitted media or post a reply in which they can choose to add portions of previous whiteboards.

To demonstrate this, let's examine a typical session using the asynchronous whiteboard. An initial student navigates to one of his or her peers' projects within the IOS system. Having decided to formulate a whiteboard message, the student can choose to create a blank whiteboard or can choose to include a media file as a background image. The student then proceeds to select from an array of vector tools, including lines, arrows, rectangles, ellipses and text. Just like most common paint and drawing applications, the student can control line width, color, position and size of the markups he or she creates. The whiteboard application also allows the student to change attributes after the markup has been created as well as control z-buffer ordering of the vector objects. The student also has text-based options of adding a subject line to their markup as well as a textual message. Once complete, the student selects the submission option and the content of the whiteboard are transferred to the server. Similar to the commenting system of the original IOS system, once a whiteboard image is submitted, it becomes a permanent addition to the project.

After completion, other students in the class can view the whiteboard entry just as they view a comment. Scrolling through the comment and critique window, messages with an associated whiteboard entry are displayed with a whiteboard icon and hyperlink. Clicking on the whiteboard icon activates the whiteboard, allowing the viewer to see the markup and associated comment simultaneously.

Students wishing to contribute another whiteboard have two options available. The student can either create a whiteboard response as a new posting, whose interaction model is the same as the initial students experience, or the student can post a reply. When the whiteboard enters reply mode, the student can select ancestor responses within the threaded hierarchy. The student is provided with the subject lines of the ancestors as well as the ability to view the ancestor layer layout. When the student selects previous responses to include in their reply, the whiteboard application incorporates the replies into the response in the form of layers. The whiteboard does not actually integrate the replies into the response, but instead stores the references to the other layers. By using a layering system, we ensure the integrity of the original response while allowing a mechanism in which students can use a previous post to their advantage. Once the layers are selected, the student can create his or her own markup on the top level. During construction, the replying student can also enable, disable, or temporarily hide a layer. These modifications to previous layers can only be done as a whole, preventing misinterpretation or misuse of a previous whiteboard posting. Once complete, the student submits only the new markup to the server along with references to the included layers.

Whiteboard Representation and Storage

One of our most difficult design decisions pertained to the method by which whiteboards would be stored and retrieved. One of our first design decisions that would have an impact on representation and storage was the use of vector-based drawing over that of raster based. Although we wanted to have the power and expressive ability of raster-based graphics, we realized that as replies began to include multiple layers, download times for our distance learners would become unacceptable. Our compromise was the ability to select a background image from a posting to use within the whiteboard. This insured that raster-based download time would be about the same as the image itself.

One of our more difficult design decisions was how to actually communicate between the whiteboard client and our server, and how would the data be stored and retrieved. Our initial design called for the use of an application-based client-server model. In this model, a stand-alone application would reside on the server and a Java Applet would use a combination of a request/response protocol and serialized objects to transmit the information. The protocol would be utilized via a TCP/IP connection originating from the client to the server.

When we started to develop the whiteboard using the serialized client/server approach, we ran into several problems. The largest problem was that our development team was spending a great deal of time developing the actual protocols and serialization routines for communication. This development often mirrored the mechanisms already in existence in readily available web server systems, including request and response data streams as well as advanced session management. As the development progressed, we often found ourselves wondering if we could take advantage of the existing HTTP based mechanisms without loosing the power of the client/server model. The other problem involved the serialization of our vector object. Since the serialization of a java object creates a binary encoded representation of the object, we had to build tools specifically designed to parse and debug the whiteboard output.

After contemplating these problems, we began to investigate other methods via which we could develop the whiteboard. Our second approach used the Extensible Markup Language (XML). XML is a meta-language via which developers can define their own markup tag semantics. XML's major strength is that it can leverage existing HTTP transport mechanisms to accommodate the transmission of content.

Inspired by XML Markup languages such as the Precision Graphics Markup Language (PGML), Vector Markup Language (VML), and Scalable Vector Graphics (SVG) (World Wide Web Consortium 99), we have created a subset and extension Document Type Definition (DTD) in order to represent elements of the whiteboard. There are two tagging levels to our DTD. The first level of our DTD allows us to denote vector content. These tags represent a collection of vector primitives that correspond to the creation controls within the whiteboard client application. Each object is represented by the vector type (line, arrow, rectangle, ellipse), stroke width, line color, fill color, and position. The object definition also embeds a list of relative points that define the shape of the vector object.

The second portion of our DTD corresponds the layering system. Two types of tags were created, an identification tag and a linking tag. The identification tag was developed to provide author information and global attributes of a layer, such as background color and/or image. The linking tag allowed us to implement the non-destructive layered reply system. The linking tag attributes also determine which if the link is enabled or disabled for the particular reply.

Since XML employs an ASCII file representation similar to that of HTML, we found that could read and analyze the content of our whiteboard-generated files. Also, the XML content was easily integrated with our current web server system. Both of these features also made it possible to perform both XML parser and server debugging of our application. Throughout the debugging process, examination of trace points revealed readable text instead of binary representations of our data. This also meant that we did not have to spend valuable developer time of the creation a proprietary debugging and analysis tools for IOS's whiteboard.

Whiteboard Implementation

We eventually chose to implement the client portion of the IOS whiteboard system as a Macromedia Director Shockwave Application (Macromedia 00). We chose Director Shockwave over other technologies for several reasons. First, Director has strong support for the use of vector media and provides a large selection of vector manipulation functions. Second, Director supports the linking and manipulation of a wide variety of media types. This includes all web media formats such as GIF and JPG, as well as non-web ones including Photoshop PSD. Third, Director provides a very user-friendly XML parsing extra. Finally, Director Shockwave movies are designed to be cross platform, cross browser independent. All that the user needs is Shockwave plug-in. With the ever-increasing popularity of Shockwave, most users often find that they have Shockwave already installed in their browser. We also took advantage of Shockwave's dexterity at manipulating non-web media for students only submitting a single image. We actually view the image within the Shockwave application with the whiteboard functions disabled. This allows us to simulate in-place activation of the whiteboard similar to the in-place activation mechanism of Microsoft Windows applications.

On the server side, very little modification had to be performed. We altered the upload portion of IOS to allow a multi-part mime encoded XML document to be uploaded. The client uses a standard HTTP post message to transmit the contents of the whiteboard to the server. The server uses a XML snap in to analyze the submitted file. The server proceeds to validate the XML file against our DTD as well as authenticate the submission. Once complete, the file is stored on the server in a whiteboard directory associated with the student project and the file link is stored in the IOS project database. The server side avoids contention and synchronization problems though its adherence to the threaded-newsgroup model.

Assessment

We are currently testing the IOS Whiteboard system with a small number of students who are acting as our beta test pool. We are interested in the usability of the system through both quantitative and qualitative measures (Constantine 99). The initial presentation of the whiteboard to our beta group has indicated a positive response to the layer system and the vector-based functionality. We also experimented with within the group with the idea of a paging metaphor to coincide with the layering system. The paging system would allow a user to create a storyboard style response via the whiteboard. We have tentatively abandoned the paging scheme as initial usability testing showed that users were often confused as when to use pages versus layers, and when to incorporate each into the reply. In addition to comments from our beta testers, we have also added tracking mechanisms to measure how and when students are interacting with the whiteboard system. IOS has been modified to support full session tracking. IOS monitors the users navigation path and access delays through their interaction with the system. This will allow us to track the length of time users are taking to formulate their whiteboard responses, the features they are using within the whiteboard, and their preferences of the graphic based system versus the textual one. The results of assessment will also be compared against observations in learning styles literature to see if there is a correlation between students assessed learning style and the preferences within IOS. We plan to present these results in future publications.

Conclusions and Future Work

The inclusion of the asynchronous whiteboard system within IOS represents the next logical step in the application's evolution. The whiteboard and pre-existing IOS collaboration mechanisms gives students greater choice and flexibility as to how they wish to express their ideas and opinions with others. We are already planning on adapting the IOS system and whiteboard technology to other disciplines, including Computer Science and Engineering. We hope that the IOS systems capability to foster collaboration around media can also work when the collaboration is based on programming content.

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A Quality Assurance Methodology for Technology-Delivered Education and Training

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Abstract: In a climate of increased deployment of information technologies for the flexible delivery of instruction in both the higher education and private sectors, procedures for ensuring a quality outcome are becoming increasingly important. The use of a developmental process that aims to meet established acceptance criteria for a project, and one which incorporates robust evaluation methodologies to validate approach and expenses is generally a key criterion for successful grant and tender applications in this emerging field. This paper outlines a methodology for quality assurance being delivered at Access OnLine. This methodology is based on a structured framework built on sound design principles, and which incorporates project management, performance against milestones, usability and learning effectiveness adopting a 'whole of project lifecycle' approach to formative evaluation.

Introduction

Numerous factors have been leading to a rapid expansion in the adoption of technology-based educational and learning applications. These have included: the increasing sophistication of, and access to, internet, multimedia and interactive technologies; increasing pressures on educational budgets; and the need for increased flexibility in access to education due to time pressures and changing work and study patterns (Laurillard, 1993; Carrucan et al., 1998). Ensuring the success of educational applications that incorporate new technologies is however inherently a difficult process. We can nevertheless identify certain factors that contribute to this success - including assuring the quality of the process and the artefacts produced during the development process.

In this paper we discuss a methodology that incorporates relevant quality assurance (QA) services that can maximise the likelihood of project success. In particular, our approach is based on a framework that provides suitable methodological structure, and a set of underpinning principles that are grounded in pedagogical and instructional design research and provide guidance in selection and customisation of specific quality assurance services.

In the next section we shall consider educational applications and how technology has been used to improve accessibility and flexibility whilst achieving desired learning outcomes. We will look at the development of these applications and factors that influence the success of the development - including quality assurance. We then move on to propose a quality assurance framework that allows us to address QA issues in a consistent and organised fashion. We provide a theoretical underpinning to this framework - including principles that guide the creation of QA services within the framework.

We then describe specific services within the context of our framework that can be used to carry out quality assurance of specific development projects. These services have formed the core of the successful QA approach carried out by Access OnLine. We finish with some observations on the limitations of the approach and the areas that require ongoing development.

Background

Development of Technology-Delivered Education and Training

There is broad recognition within the educational computing community that computers have a special role to play as tools to enhance learning as cognitive tools (Jonassen, 1996); and are increasingly also used to deliver learning at distance (Bell & Lefoe, 1998). Having recognised that technology - and in particular internet, media management and interactive technologies - can be used to create educational and training applications that provide significant benefits in the areas of education and access, we need to consider the development of these applications. It is rather critical that the development be carried out in a way that ensures that the developed application is educationally effective - i.e. that the product helps users achieve the desired learning outcomes.

Achieving the desired learning outcomes is not the only criteria of a successful project. Other possible factors might include the extent to which the product is matched to the target audience, or the cost-effectiveness of the development process. This leads to the broad question of what characterises a successful project in this domain? And, given that technology projects are often expensive to produce, what techniques can we apply to ensure that the project is delivered on time and in budget, that it functions as expected by end users, and that it meets business and marketing expectations?

These questions have prompted research (largely driven by project sponsors and managers interested in the reduction of risk) to examine the characteristics of a variety of instructional technology projects to develop success models. Specifically in the higher education sector, Alexander & McKenzie (1998) conducted a comprehensive review of information technology projects funded from the Committee for the Advancement of University Teaching (CAUT) in 1994-5. 104 CAUT funded technology based projects receiving a total funding of over $4 million (Alexander & McKenzie, 1998, p. viii) were included in their study, which specifically examined benefits to student learning in quality, productivity, access and attitudes; and for staff implementing the projects. Their study identified a 19 key factors contributing to a successful outcome of a project that may be broadly grouped into three categories: quality assurance, project design and project implementation.

Three categories of success factors in technology-delivered projects

We consider that there are three categories of success factors in technology-delivered projects that relate to implementation, design and evaluation. The first of these, *project implementation* considers the overall context in which the learning system is delivered. It deals with matters such as the provision of sufficient funding and executive support for the project, the manner in which the learning technology is integrated into the overall learning experience for the learner, and the way in which the training or education is managed at a managerial level. There is increased recognition (Holtzblatt, 1999; Clarke & Cockton, 1999) of the importance of an appropriate and pragmatic 'context' for the delivery of education and training. Generic technologies have been developed to deliver learning across many contexts: student management systems are becoming integrated into off-the-shelf instructional shells known collectively as 'groupware', providing a technological context for delivery of courseware. Some examples of these systems include Learning Space [HREF2], TopClass [HREF3], WebCT [HREF6] and WebMentor [HREF6]. A wide range of these large instructional management tools have been developed in recent years, providing a cost-effective infrastructure for institutional knowledge management and administration. These tools provide support that enables the implementation of the project.

Second, *project design* is a significant attribute of the project development process. It is important that the project is developed from relevant research in education and reflects an appropriate learning and design strategy. This is often based on a needs analysis, done in the project scoping stage. For example, a needs analysis of a large group of learners in a workplace context being introduced to new productivity software might specify a 'just-in-time' model of instruction, supported by a performance support system (Wild, 1998) that offers context-sensitive help for users carrying out specific tasks. The needs analysis specifies a learning model, which consists of a set of procedures, practices and specifications, supported by carefully chosen delivery technologies, grounded in educational principles, and informed by appropriate evaluation. Considerations of user profile task analysis and general design principles specify usability goals. These goals inform the criteria for the usability evaluation (Mayhew, 1999). This instructional design 'layer' of pragmatic educational principles has its roots in more formal learning theory, whether it is cognitively based (Eklund & Woo, 1998) or not.

Good project design also means successfully building project teams and managing those teams throughout the development process. It means providing the team members with support, having realistic expectations on their productivity and output, and understanding the overlapping roles that they play in the project. These are the characteristics that an experienced learning technology project manager is aware of and capable of handling, and it is recognition that the people, procedures and processes central to the design of the project are a part of that design themselves.

The final category of key factors contributing to a successful outcome of a technology project, and the focus of this article, is *quality assurance*. This typically involves a staged or iterative process of evaluation of a project throughout its lifecycle and from multiple perspectives. Typical examples include: the usability of the product, the effectiveness of the environment to meet stated learning outcomes, and the quality of the product development process itself, measured by performance against milestones. In some ways this category overlaps with the others, as one way of ensuring a quality outcome on any project is to ensure, by assessing the performance of the project team against agreed-to milestones, that robust methodologies are employed in both the design and management processes. Alexander & McKenzie (1998) note that a factor contributing to a successful learning outcome is that the "*...evaluation of both usability and student learning is carried out at regular stages during the design and development of the project, and the project is re-designed as necessary*" (Alexander & McKenzie, 1998, p. x).

The cyclical nature implicit in formative evaluation is not a new methodology by any means, but it is often overlooked in the development of online learning or other technology-delivered instructional systems. Possibly this is due to a lack of understanding about the range of quality assurance methodologies specifically appropriate to instructional technology projects. It has been suggested (Canale, 1998) that the wide diversity in multimedia projects calls for a flexible approach to project management, and that risk reduction and maximising effectiveness should be the priority goal in delivering an instructional technology project. Indeed, it is claimed that the quality of the project is directly determined by the effort put into evaluation (Philips, 1997) and is critical for bringing it under budget. The need for robust quality assurance is supported by these observations.

A further important reason that quality assurance needs to be considered is that the incorporation of a clear and comprehensive evaluation strategy is becoming critical to obtaining funding for new projects; in winning grants, tenders and submissions. This also provides a means of ensuring that project sponsors maximise their chance of a successful project outcome and return on investment.

The purpose of this paper is to describe a whole of project methodology for quality assurance for technology-delivered education and training. The methodology is appropriate for both higher education and private sector training. This methodology is being delivered in a commercial, cost-effective manner at Access OnLine [HREF1].

A Quality Assurance Framework

Framework Dimensions

Before we discuss the QA principles or services, we wish to look at the aspects that QA should encompass and then use this to construct a framework guiding our QA efforts. Considering QA, we can identify two key dimensions: how we ensure quality, and what aspects are having their quality assured. Let us look at the first of these two dimensions.

Quality can be assured through two main types of activity: advocacy (the provision of guidance) and auditing activities (evaluation). Guidance focuses on providing input into the process prior to carrying out activities. This guidance can support the adoption of suitable development methods, or provide advice as to the form of the product being developed. At a practical level guidance occurs through consultancy (either internal or external). At Access OnLine, personnel work closely with clients and offer expert advice throughout the development lifecycle - guiding or mentoring the developers. The second type of activity that helps in ensuring quality outcomes is evaluation. Whereas guidance is aimed at avoiding problems with the product being developed or inefficiencies in the development practices, evaluation serves to identify these problems when they do occur. Ideally, we wish to identify the flaws as early as possible, and as such the evaluation should occur throughout the development process. In effect, evaluation occurs at various points in the development of a product, is implemented in different ways, but each evaluation point is essentially a stand-alone review process that offers an independent perspective on some aspect of the project.

The second dimension of our framework considers to what we are applying QA. In the previous paragraph we alluded to this several times. The guidance being provided supports both what we do and what are producing. The evaluation checks for flaws in both the product being developed and inefficiencies or other faults in how we approach the development. In other words we are assuring the quality of both the final product, and the process by which the product is developed. It is worth observing that, in effect, both ultimately relate to ensuring the quality of the product - one directly, and the other indirectly. By ensuring that our development process and practices are of high quality, we are maximising the likelihood that they will result in suitable products.

The outcome of the above observation is that we can create a basic framework for QA as shown in Figure 1. Within this framework, we can identify various QA activities that can be carried out - or in a consulting context, services that can offered to clients. This general framework will be applicable to QA within any application domain. The next step is to customise it to our specific domain – namely technology-supported education and learning.

Framework Principles

Rather than simply arbitrarily selecting services that fit within the above framework, we can begin by identifying the underlying principles upon which we are constructing products - and hence should be carrying out QA activities. These principles will typically be domain specific. So, for example, with educational applications we can identify a set of relevant principles that can be shown to support the creation of effective applications. These same principles form the foundations of the QA services.

We have identified the following key principles:

- User-centred design
- Instructional design
- Heuristic evaluation
- Incremental evaluation

Each of these principles will affect different services. The primary domain of relevance of each of these principles is shown in Figure 1. In other words, *Instructional Design Principles* will underpin both guiding the design of instructional products, as well as providing metrics that underpin the evaluation. We briefly look at each of these principles in turn.

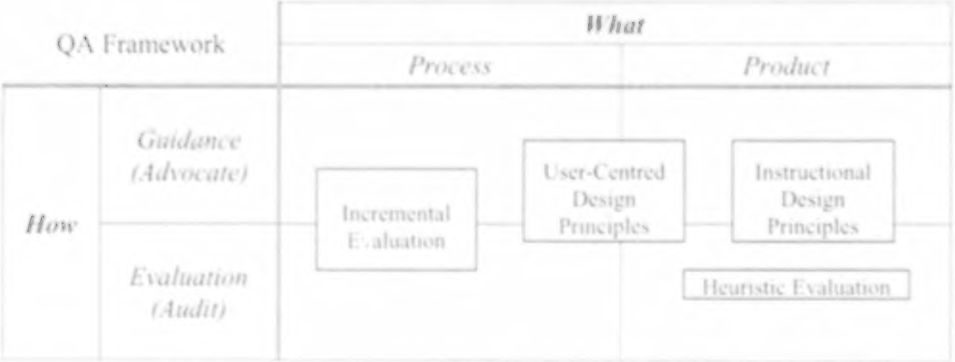


Figure 1: QA dimensions

Principle: User centred design processes for interactive systems

A set of developing international standards (ISO 13407) for user centred (also known as human centred) design processes for interactive systems underpins both the guidance and evaluation of process and product. These standards are a sub part of standards for "software quality in use". The principles outline an iterative development and evaluation cycle for the life of the product. The main steps are:

1. Plan the human centred process
2. Specify the context of use
3. Specify user and organisational requirements
4. Produce design solutions
5. Evaluate designs against user requirements

User centred design principles are an overarching set of guidelines for project management and the establishment of test plans.

Principle: Instructional Design Principles

Instructional design is a new science based on established educational theory. It is arguable that ultimately it offers nothing new from an educational perspective, only from the technology that is used to deliver the learning. Instructional System Design (ISD) examines pragmatic ways in which we may format and present learning material using new technologies. Many ISD principles are simply re-stated good teaching practice, such as orienting the learner to the task, providing feedback on exercises, linking assessment with objectives, pacing, and so forth. However, there is a set of design principles that are technology-driven as well, that is, they are medium-dependant. These include screen layout issues, the use of authentic case study materials presented via sound and visual elements, and the use of asynchronous discussion lists.

Principle: Heuristic Evaluation

Heuristic evaluation, otherwise known as the 'expert review', is a cost-effective means of evaluating a developing product against a set of design guidelines, or heuristics. This is performed by a usability expert, who leverages his/her experiences with user-based reviews to measure the product against a set of pre-defined rules (see also Neilson & Mack, 1994). This procedure is often performed as an initial check of the usability of a product prototype in order to highlight major design flaws in navigation, content, conceptual model, strategic intent, and so forth. In this process the usability engineer should have a clear idea of the target users for the product and well as the context of use.

Principle: Incremental Evaluation

A well-established principle in numerous technical development domains is that of continuous or incremental evaluation, otherwise known as formative evaluation. Leaving the evaluation of a product until the development is complete may appear to save time during the development, but it inherently means that any flaws that are introduced are not identified until very late in the development, compounding the costs of rectifying the flaws. For example, empirical data in software engineering has shown that the cost of rectifying a flaw located during the implementation stage can be orders of magnitude higher than the cost of rectifying the same flaw identified during the initial requirements analysis. This issue is just as true for development of IT-based education systems. Unfortunately, common practice with the development of many Websites is to leave any evaluation (such as usability testing) until the site is completed. A much more appropriate approach - though one that requires rigour to maintain - is to undertake ongoing evaluation as the site or product is developed. Different system increments can be progressively evaluated. For example, designs can be evaluated by analysing storyboards or educational scripts against the instructional design pinciples. Requirements can be evaluated against potential user scenarios. Different components of the product can be evaluated as they are implemented. The result is that we identify flaws or potential improvements early in the development process.

QA Services

QA services offered at Access OnLine that are either involved in guidance or evaluation or most often in combination have at their core the principles described above. In this section, we briefly outline services, products and techniques (Figure 2) that support this approach within the established framework.

QA Framework		*What*	
		Process	*Product*
How	*Guidance (Advocate)*	Project Management	Acceptance Criteria
	Evaluation (Audit)	Performance against Milestones	Usability Evaluation Learning Effectiveness Evaluation Technical Testing

Figure 2: QA Services

Acceptance Criteria

Acceptance Criteria include complete test plans that describe key milestones at which testing should be conducted. Completion of testing and satisfactory correction of any issues reported will provide the project team with risk management. Testing should include bug testing, compatibility, performance as well as usability. The purpose of setting acceptance criteria is to set a clear and concise set of goals for the project to enable all the stakeholders and participants to understand exactly what the final product should be like. The document describing the acceptance criteria outlines recommended acceptance criteria for a particular project. These should be set in conjunction with all stakeholders to be a valid reflection of the project requirements.

Usability Evaluation

Usability evaluation is performed by a user-based review of a product in what is most often a combination of qualitative and quantitative data to determine the performance of the product against a set of criteria or tasks and in a specific context. Such a review is intended to provide formative evaluation to assist developers with the further development of the product in accordance with the principles of user centred design (ISO 13407 Human Centred Design Process for Interactive Systems).

In this context, usability is defined as "...the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". This is a component of the broader set of criteria termed Quality in Use (ISO 14598-1).

Usability is measured with three key metrics:

- *Effectiveness*: The accuracy and completeness with which users achieve specified goals
- *Efficiency*: The resources expended in relation to the accuracy and completeness with which user achieve goals
- *Satisfaction*: The comfort and acceptability of use

Learning Effectiveness Assessment

This is a critical component of whole of project quality assurance is the determination of the effectiveness of the system in achieving educational and training goals. Do users learn from it? Do they enjoy using it? When learning with technology is designed, there is an educational outcome intended. The goal of learning effectiveness assessment (LEA) (Eklund, Alem & Quinn, 1999; Alem, Quinn & Eklund, 1999) is to provide a means of measuring the attainment of learning outcomes against a set of both design and acceptance criteria. We consider that the basis for evaluating the effectiveness of a learning environment is how well a number of key instructional features are supported by such an environment (design factors) and how much the learning environment has been accepted by the learner (acceptance factors). The design factors include: Instructional goals; Instructional content; Learning tasks; Learning aids, and Assessment.

Performance against Milestones

Performance against Milestones ensures the main developer of the project materials conforms to the project outline and performance measures established in the project agreement. The project schedule details a set of milestones (usually sign-off points) in the process. We can assess the performance of the developer in meeting these milestones in both time and quality by referring to the acceptance criteria established at the outset of the project. This is really a method of ensuring that the acceptance criteria are used explicitly, and is often directly related to the developer's receipt of progress payments.

Project Management

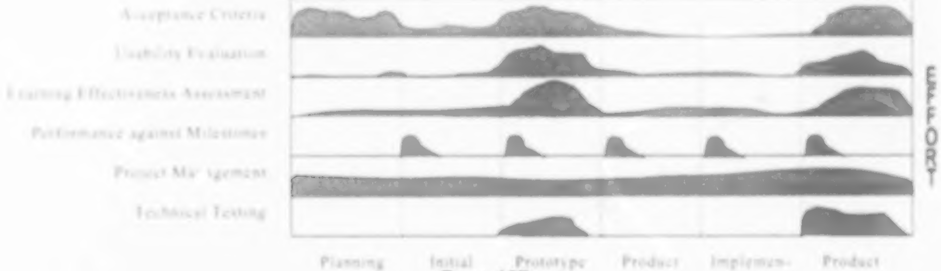
Project management (often called 'production' in new media circles) is a particular skill that requires a knowledge of scheduling and organisational techniques as well as a particular understanding of developmental processes for interactive media, namely ISO 13407: Human Centred Design Process for Interactive Systems. Providing consultancy about best practice in the project management aspects of a new media production is one key method for ensuring a quality outcome for all stakeholders in a production.

Technical Testing

This component of evaluation audits the functional aspects of a system: Are there coding errors? Does it work efficiently and correctly according to the technical specification? Has it been developed according to acceptable standards of programming? Is it compatible with other software platforms? Once again, the technical specification is the 'design' document against which the product is compared, and obviously the product's technical robustness is part of its acceptability.

Application of Services

The above descriptions outline a series of QA services that fit within a consistent framework and that can be applied to the development of technology-driven educational applications. What we have not discussed however is when these services should be applied to achieve maximum benefit. Certain of the quality assurance services are relevant to all stages of the development. Others are more relevant just to specific development activities. Figure 3 illustrates this point – where the emphasis and effort applied to different services varies depending upon the stage of development. For example, usability evaluation activities are primarily focused on evaluation of prototypes (which are developed with the explicit purpose of understanding user needs) and final applications.



Our current work is continuing to look at how these services should be effectively integrated into the development process. In particular, ongoing research is looking at creating heuristics that can guide developers in the effective application of QA services to appropriate stages of the development.

Conclusion

In this paper we have discussed a framework for supporting the quality assurance of technology-delivered education and training. The general framework proposed is applicable to QA for any technological systems, though we have explicitly shown how it can be used to structure the application of general principles. In our particular case the framework has allowed us to identify the areas of applicability of well-established pedagogical and evaluation principles. These principles have then enabled us to place in context specific QA services that enhance the likelihood of a successful development outcome for educational applications.

Future work will be to refine the principles and make clearer the connections between the principles and the underlying services. We shall also look at undertaking empirical evaluations of the impact on project success of a systematic approach to QA.

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Hands-on Science Centres around the World: How do they rate in their use of the Web?

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Abstract: Throughout the developed world there exist many Science Centres that aim to introduce people of all ages to Science and Technology. These Centres have as their brief the promotion of a greater understanding of Science and Technology in relation to today's social, educational and business environments. They adopt a constructivist approach and offer hands-on experiences with a wide variety of interactive displays, exhibits and experiments. The traditional offerings of these Centres involved various physical apparatus housed in publicly assessable buildings and subject to the usual restrictions of demand, available space and hours of operation. Other issues involved the need to keep equipment functional and secure.

By the mid 90's the Web had developed to a point where free or low cost multimedia capable browsers, and suites of development tools, made it feasible to offer online, virtual experiences that allowed "hands-on" learning and experimentation by a rapidly expanding global audience without the physical restrictions of traditional learning environments. Hands-on Science Centres began to move some of their offerings into the Web.

This paper reports on a survey of 97 Science Centre Web sites whose URL's were collected in the period 1995 to 1999 then examined in late 1999. The sites represented centres located in 20 countries around the world. However, as might be expected, the majority were from the USA. The sites were rated on 25 parameters that aimed to provide a comprehensive picture of their operational structure and their use of various Web features and technologies. An analysis of the survey results illustrate how Web technologies are being used and give some idea of the quality of sites being built by science-based educational developers operating from a constructivist perspective. Individual sites provide useful ideas, approaches and instructional models for anyone developing Web-based instruction.

Introduction

Science Centres come in a range of shapes and sizes and with varying histories and background credentials. Some were established and had achieved an international reputation before the Web was invented, for example, the Exploratorium (http://www.exploratorium.edu) which is housed in the Palace of Fine Arts in San Francisco. Others are relatively new and purpose built, such as Questacom (http://sunsite.anu.edu.au/Questacon/) in Australia's national capital, Canberra. Questacon opened its doors the year before the Web was invented. Another group has been developed as virtual extensions of an existing museum or science research facility, for example, the Institute and Museum of the History of Science (http://galileo.imss.firenze.it/) in Florence, Italy.

Prior to the mid 1990's the primary method of access was for the public to travel to the location of the Science Centre, queue for a ticket, then once inside move around the exhibitions and experiments at the rate the crowd would allow, then leave on or before closing time. Some centres attempted to expand their provision and audience by mounting traveling displays and exhibitions. Indeed for some centres, such programs have expanded their annual audience from hundreds of thousands to millions, and touring programs are now an integral part of many centres annual activities.

As the Web moved out of the high energy physics community and into the educational community in the early and mid 1990's, it is not surprising that the staff of Science Centres recognised the potential of this new communications technology for Science Education. A few Web sites started to appear as early as 1993 but it was not until 1995, with the development of graphic capable browsers and public access to the Internet and the Web began to accelerate, that more and more Science Centres moved onto the Web.

Approaches to Learning and Knowledge Building

Feher (1990) puts the case that for many people the traditional teacher-directed approach to learning about science is abstract and often boring because there is nothing the learner can do with it. Textbooks, notes and even face-to-face lessons and lectures all make statements about various physical properties or scientific phenomena, but provide no way that they can be tested by the reader/learner.

Hands-on Science Centres have always been aware of these shortcomings and have based their approach on Constructivism and the ideas on the likes of Dewey (1938), Bruner (1967), Piaget (1973) and Vygotsky (1978). Constructivism has been identified as a philosophy, a theory of learning and a faction within cognitive psychology. Basically a constructivist view of learning sees the learner construct knowledge as an attempt to make sense of his or her experiences. Knowledge construction is a function of prior experience, mental structures and the beliefs an individual uses to interpret objects and events (Jonassen, 1991). Science Centres seek to facilitate knowledge construction by providing the experiential component of this process, as well as some of the contextual information that could be used by the individual to interpret his or her experiences. They adopt a learner-centred approach.

A Profile of a Hands-on Science Centre and its Web site

Questacon is Australia's National Science and Technology Centre and was established in Canberra, the national capital, in November 1988. Its brief is to promote public understanding of science and technology. In particular the Centre was designed to encourage hands-on interaction with experiments, rather than present displays that were static or operated on a pre-determined cycle. It now maintains hundreds of hands-on, interactive exhibits and together its Canberra Centre and touring exhibitions are rated as one of the world's major Science Centres. Each year over 300,000 people visit the on-site facilities in Canberra and over 1,000,000 people experience the Centre through its touring program which now extends into Pacific, Asia and other parts of the world.

In May 1995 the Centre moved to improve access and widen its potential audience by launching its Web site < http://www.questacon.edu.au >. The site initially offered a virtual tour of the five on-site galleries at the Centre and a range of interactive, online activities. The site has continued to evolve both in terms of its content and the tools and Web technologies used to deliver activities. Even in the first few years of operation the Web site won a number of awards and commendations including:

- Top 5% of All Web Sites - Point Communication Award, 1995
- Best Site for Children, - Berit, 1995
- "World Wide Web Top 1000" - Point Communication and R.L. Holzanagel 1996
- Best of the Web Award - Platinum Site - NetGuide Awards Program, 1997
- Five Star Web site - World Wide Web Yellow Pages, 1997
- Winner Editor's Choice Award - The Bonus Network, 1997

Not all Science Centre Web sites have received such acclaim. Some provide simple "point and click" access to various text and graphics information. Indeed the first use of the Web by some centres was simply to advertise on site exhibits and opening times rather than provide online activities that involved interaction.

By the late 1990's the number of science centres on the Web had increased substantially. A list of 97 appears at < http://allan.scu.edu.au/sciencecentres.htm > but as this is only a sample of sites located by one of the authors, it could be assumed that the total number of sites worldwide is greater, perhaps approaching 200 or more.

As new Web-based tools for the delivery of education and training programs continue to be developed, the activities and offerings of Science Centre Web sites provide a potentially rich source of ideas for educators, as well as a measure of how the latest in Web tools and technologies are being used.

The Survey

The 97 sites listed at < http://allan.scu.edu.au/sciencecentres.htm > can be regarded as semi-random sample of worldwide sites. The breakdown on the basis of country is shown in Figure 1.

Location (Nationality)	**No. of sites**
USA	56
England	7
Canada	7
Australia	4
Sweden	3
Japan	3
France	2
Finland	2
South Africa	2
Italy	1
Korea	1
Scotland	1
Singapore	1
Spain	1
Isreal	1
Switzerland	1
Taiwan	1
Netherlands	1
Germany	1
Denmark	1
TOTAL COUNTRIES = 20	**TOTAL SITES=97**
<404 NOT FOUND>	**18**
SITES USED IN SURVEY	**75**

Figure 1. Breakdown of sites based on location.

These sites were collected over the period early 1995 to early 1999. The survey reported here was conducted in late 1999, hence one would have expected some sites to report <404 site not found> errors, a reflection of the ephemeral nature of the content of the Web. What was not expected was that the figure would be as high as 19%, that is, 18 sites (Figure 1). One possible explanation relates to a similarity amongst many of the missing sites. Most of the 404 sites had complex, difficult to identify URL's, for example, < http://www.casaciencias-lc.es/WEB/English.htm >. It is possible that such sites have either moved to a more logical URL or perhaps even shut down due to low traffic (possibly resulting from awkward URL!). What is not explained or understood is why pointers to these new sites have not been maintained.

Assessment of the characteristics of the Web sites in the sample n=75 included an initial checklist of 10 basic features. The first 8 were scored as either being "present" or "not present" and the final 2 rated on specific characteristics.

1. Webmaster - Each site was checked for the presence of a Webmaster@ email contact on the front page/top level.
2. Copyright - Each site was checked for use of copyright symbol on front page or top level of the site.

3. Statement of Objectives - Analysis included the search for a statement of site objectives i.e. "At this site you will find resources for...." or "These resources are useful for...." etc.
4. Disclaimer - The sites were checked for use of legal disclaimer.
5. Frames - Were frames used throughout the top level of the site?
6. Accessibility - Were ALT (image descriptor) tags used throughout the site?
7. Request Information - The ability/invitation for users to request further information.
8. Server Response - Science based activities that required a response from the Web server.
9. Navigational Interactivity - Use of javascript and other "intelligent" ways of determining/assisting user movement throughout the site. Most sites did not use anything more than standard hypertext navigational techniques. links = standard hypertext links, dynamic = javascript and/or dynamic methods (cookies etc).
10. Content - Whether or not the site is purely informational i.e. opening hours etc or whether the site contains activities and other resources. information = static information resources only, activities = interactive resources.

The second checklist surveyed the use of Web-based multimedia technologies. Again the sites were scored "present" or "not present".

1. Java Applets - Were Java Applets used on the site?
2. Animated GIFs - Were animated GIF files used on the site?
3. Flash - Was Macromedia Flash used on the site?
4. Shockwave - Was Macromedia Shockwave used on the site?
5. QT Movies - Were QT Movies used on the site?
6. QTVR - Was QTVR used on the site?
7. Streaming Audio - Was Streaming Audio used on the site?
8. Streaming Video - Was Streaming Video used on the site?
9. Slide sequences - Was PowerPoint or similar display formats used on the site?
10. DVI - Was DVI used on the site?

The third phase of the survey addressed 5 parameters that aimed to collect some semi quantitative data rather than a simple present/not present assessment. It sought to differentiate the sites in terms of the clarity with which they defined their target group and the overall design and image quality. The items surveyed and the rating scales used were:

1. Target Group - We searched for a statement of who the site targeted: 0 = no description, 1 = minor effort to describe, 2 = significant effort to define target group.
2. Clarity - The degree to which the content of the Web sites is easily conveyed to the viewer, eg written in plain language, good use of key words to facilitate scanning etc 0 = not at all clear, 1 = partial explanation, 2 = good logical clarity, 3 = Very clear explanation.
3. Consistency - The degree to which a consistent and recognisable look and feel was used throughout the site, consistent use of visual and navigational conventions, commonality in design. 0 = not very, 1 = some consistency, 2 = consistent throughout the wite.
4. Quality (graphics) - The quality of the graphics used throughout the site. 0 = very poor bitmapped, 1 = standard look, probably not specifically developed for the site, 2 = Good graphics correct use of JPG and GIF, 3 = Professional quality web graphics that appeared to have been designed specifically for the site.
5. Quality (photos) - The quality of photos used throughout the site. 0 = very poor, 1 = average scans, 2 = Good use of photo realistic JPG compression, 3 = excellent, professional quality.

Results

Ratings on general site characteristics are summarised in Figure 2. The results show less attention to detail than expected. Only identification of a Webmaster, a copyright statement and accessibility rated higher than 50% for all sites. A disclaimer was present on only 3% of sites which is indeed surprising given that such a high proportion of the sites are US based, where litigation and potential legal issues are always are concern for those organisations that interact with the public. The fact that 16% of sites displayed only simple information indicates that for some centres keeping up with the potential of new Web tools and technologies did not seem to be a priority.

Characteristic	Present	Not Present
Webmaster	74%	26%
Copyright	51%	49%
Objectives	49%	51%
Discalmier	3%	97%
Frames	21%	79%
Accessibility	51%	49%
Request Information	16%	84%
Server Response	8%	92%
Navigational Interactivity	16% links	84% dynamic
Content	16% information	84% interactive

Figure 2 Summary of general site characteristics.

Ratings on technology features, in particular those that indicate a site is attempting to deliver multimedia content, are summaried in Figure 3. These indicate that apart from the use of animated GIF's very few sites are exploiting the latest Web tools and technologies. This overall response pattern is surprising when you consider that the ability to run Java applets and play QuickTime movies has been a standard feature of most browsers for some years. The need for proprietary, user installable plug-ins may explain the low use of some of the other animation tools. It is surprising that slide sequences, a well-established educational tool, were not used.

Overall the results indicate that use of the Web for multimedia content delivery is patchy, with most sites using only one or two of the available technologies. Only a few sites make extensive and varied use of the available Web technologies. The most recent technology rated, DVI, was not located on any of the sites examined.

Technology	Present	Not Present
Java Applets	5%	95%
Animated GIFs	60%	40%
Flash	3%	97%
Shockwave	9%	91%
QT Movies	9%	91%
QTVR	9%	91%
Streaming Audio	3%	97%
Streaming Video	0%	100%
Slide Sequences	0%	100%
DVI	0%	100%

Figure 3. Summary of technology features of sites

Results of the third, semi-quantitative rating checklist are presented in Figure 4. This shows that the vast majority of sites rated 0 or 1 (poor to average) on the five parameters rated. Only a few sites were rated at the highest level on the scales used. There is clearly scope for most centres to make substantial improvements in many aspects of their sites use of available Web technologies and tools.

Parameter	Rating=0	Rating =1	Rating =2	Rating=3
Target Group	53%	44%	3%	N/A
Clarity	21%	44%	31%	3%
Consistency	31%	68%	1%	N/A
Quality (graphics)	25%	59%	13%	3%
Quality (photos)	21%	63%	15%	1%

Figure 4. Summary of semi-quantitative ratings of site content.

Discussion

Given the assumed knowledge and resource base (staff and equipment) and educational philosophy, it is surprising that more Science Centre Web sites do not rate better on many of the checklist items. Indeed many sites could be regarded as at least several years "out of date" in terms making use of the latest in Web technologies and tools. Many sites rated only average to good in terms of parameters like clarity, consistency and quality (graphics and photos) when many visitors might expect such sites would be exemplars of this type of educational content delivery.

It was beyond the scope of this pilot study to undertake any detailed assessment or ranking of the overall educational effectiveness of these sites (the task for another project and paper). Because the sites rarely deal with identical content, direct comparisons would not be easy to make. As a representative sample of the range of sites available, the names of 5 sites, their URL's and some notes taken during our visits, are presented below:

The Exploratorium < http://www.exploratorium.edu >
Has a copyright statement; objectives clearly stated; target market identified; uses ALT tags. Scored high on quality of graphics, photos and overall site consistency. With regard to media used this site has basic and high-end media ranging from animated GIF's, to Shockwave, and Flash. It also used both streaming audio and video. In one experiment used it used JavaScripts that calculate braking distances and energy consumption. Uses Shockwave to demonstrate interactive movement. Uses Webcasts of skateboarders to demonstrate gravity and momentum. Some non-English language options available. Overall an extremely well developed and maintained site.

Tech Museum of Innovation < http://www.thetech.org >
Uses frames and ALT tags; didn't have copyright statement. Used very high quality photos and graphics thoughout the site but was not entirely consistent in look and feel. Did use of JavaScript and other "intelligent" ways of determining/assisting user movement throughout much of the site. Uses animated GIF's and Shockwave to demonstrate the mechanics of animal structure and movement. Good quality graphics used for this. Uses streaming audio and video to cast interviews with scientists and people of interest to the science community. A very well developed and interesting site.

Santa Barbara Museum of Natural History < http://www.sbnature.org >
This site actually crashed one the author's computers several times while it was being explored. A rather crude "old 95" style look and feel with poorly animated GIF's combined with some high tech use of Webcam (for displaying whale skeleton). Mostly informational. Plenty of scope for improvement.

Deutsches Museum < http://www.deutsches-museum.de/e_index.htm >
This German site had many resources displayed in English. Very clear and easy to understand site navigation. Copyright statements present. High quality graphics and very high quality photos. Extensive use of QuickTime technology. Uses QTVR to show inside diesel engines. Uses Web cams to show what's happening in the Museum, QT movies showed old mechanical devices working etc. Used JavaScript to "switch" things on and off via the browser. A good example of a professionally developed site.

Museum of History of Science < http://galileo.imss.firenze.it >
Slightly older style look and feel with good quality graphics and photos. Easy to understand flow and site design; copyright and contact to Webmaster prominently displayed. Extensive use of QTVR to show Galileo's tools and - walk around the museum exhibits and zoom in on objects etc. Site available in English and Italian. Good example of a site built around a pre-exiting collection.

Questacon < http://www.questacon.edu.au > And of course don't forget to visit this Australian site.

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Design and Deployment Decisions within an E-Commerce Environment

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Abstract: E-commerce is opening new markets as well as extending existing business practices. It includes such diverse activities as electronic trading of goods and services, on-line delivery of digital media content, share trading, electronics funds transfer, commercial auctions, public procurement as well as direct consumer marketing. While the technologies and business practices associated with the web hold great promise with potential significant efficiency gains or market growth, the area is relatively new and lacks the knowledge base required to support decision-making.

This paper examines the potential of using option theory as a structured and explicit way of thinking about possibilities, actions and decisions, allowing managers to react to future conditions and enhance decision making in this new and evolving technology and business domain.

1. Introduction

Reports from the International Data Corporation (IDC) highlight the potential for an explosive growth in Internet based services with an expected growth from 4.5 billion dollars in 1997 to 43.6 billion dollars in the year 2002, (E-commerce, 1999). E-commerce lies at the heart of this growth and the use of the Internet as a business platform that offers the potential of global marketing of products is proving to be a powerful enabler for both large and small businesses. However an efficient e-commerce strategy requires investment in suitable specialist tools, personnel along with a prudent analysis of the proposed business operations. A key ingredient in this business is decision making; if and when should a company invest in a new market or technology?

While e-commerce is shaping how the businesses of the future will operate, it is not a new phenomenon. For several decades organizations have exchanged data over a variety of communication networks. However the Internet has advanced this traffic and introduced millions of new potential customers and enabled new markets that overcome many of the national, geographic and temporal boundaries that have traditionally been a barrier to trade.

Faced with this rapid development, many companies now find themselves involved in new and difficult investment decisions ranging from multimillion-dollar high technology projects to, when and how to introduce an effective web presence. In a situation where uncertainty masks whether investment will provide a satisfactory return, waiting for more information before excising the option to invest should have some value. In this situation, modeling the decision process in the context of "options pricing" could offer a company a better way of evaluating the best time to make an investment and give a handle on the asset's expected value.

The concept of options is not new; we are constantly meeting option decisions everywhere in our daily lives. Options give us freedom, and the more options we have the more flexibility we have to react to changing conditions. In the financial domain it is not uncommon for fund managers to invest in a company at a price greater than its current value in order to open up new options and give them greater flexibility should circumstances change in the future. Real option theory helps them in this task and provides a structured and formal way of expressing what the connection is between possible actions, time and decisions, providing a rationale for what good managers have been doing intuitively for years.

2. Modeling Decisions

Many design and deployment decisions within an e-commerce environment are highly complex involving many factors. A large number of these factors are difficult to precisely quantify, leaving the decision process to fall back upon historical ideas and rhetoric as a basis for decisions. While many of these ideas have merit, it is difficult to evaluate their 'worth' due to their lack of formality. One obvious approach to this evaluation problem is to associate economic cost and benefit with these design decisions. In addition to the cost and benefits, these designs also involve potentially a great deal of risk which should be factored into the evaluation framework. Fortunately the world of microeconomics provides such a framework "decision-making under uncertainty" (Smith, Nau, 1995). This framework uses real options as a mechanism for evaluating such designs. Recent work (Trigeorgis, 1996), suggests that the real options approach can to utilized to model capital investment decisions. This paper argues that design and deployment decisions within an e-commerce environment can be viewed as permanent, but delayable, decisions which cause the investment of resources (manpower, equipment, finances…) to realize the vision to the decision embodies. This approach differs from traditional approaches, which fail to consider the risk component within the evaluation process.

3. Traditional Approaches

The traditional economic approach to evaluating such decisions utilises net present value (NPV). In a NPV approach, the decision-marker evaluates their decision by first estimating the present income stream that the investments will produce. In a realistic situation, this estimation process is uncertain and several input streams will potentially exist. Hence, the decision-marker attempts to associate with each stream a probability of occurrence, and sum these weighted quantities, to produce an expected position. Next, a similar process is undertaken for the expenditure side; and hence the NPV is simply defined as the difference between input and output streams. Now a simple decision is made upon the sign of this value (Ross *et al.*, 1996). One additional factor to be considered before proceeding is the cost of money. The net present value factor accounts for the fact that a sum of money received or spent in the future is not equivalent to that same sum of money currently on hand. The difference is due to the fact that a given sum of money invested today at a given interest rate will be worth more in the future (discount rate).

Unfortunately, this approach does not accommodate delaying the decision. In a NPV world, decisions are made in the current finite time frame. This fails to accurately model the real world, where decisions are often deferred, until more concrete information is obtained or the conditions become more favourable. Only at this point is the final decision undertaken. Once undertaken, the decision is nearly always irreversible as resources are committed from one day, and cannot easily be retrieved, as tangible assets are often only produced in the long-term. The irreversibility of the decisions demand the evaluation is as accuracy as possible, and that a concerted effort should be undertaken to find the optimal solution.

As indicated earlier, in a NPV world, the decision to invest is taken when the expected value of NPV is positive. Unfortunately, this assumes that the decision-maker is living in a perfectly symmetrical world; that is the potential upside and downsides of the NPV equation are balance. Again, this is an unrealistic proposition. In general the distribution of these values will be asymmetric; potentially highly asymmetric, especially in new technologies and market places as epitomised by much of current e-commerce activity. The national press regularly carries stories of e-commerce ventures receiving massive capitalisation, when floating on the public stock market. Although the basic NPV analysis can be easily extended to cover best and worst case scenarios, the extended systems still fail to capture the asymmetric nature of many projects.

Finally, NPV modelling provides a static view of the world, the evaluation is undertaken at the point of decision, and the evaluation is final (as the decision takes place at this point in time). Since options theory incorporates the possibility of delaying the decision, it naturally incorporates components within the model to allow the market to fluctuate during this 'delay period', and hence accommodate changes in the deployed discount rate or the expected income stream. Even if we changed the basic NPV approach to allow evaluation at a time after the initial decision point, it still causes problems, as the model has no way to incorporate new information as it arrives.

In the financial world, option theory allows the financier the right, but not the obligation, to purchase assets (such as stocks, shares, and futures…) at set prices for certain time periods. In an e-commerce environment, this is simply translated into the ability to evaluate the possibilities to decide now or to delay that decision in the light of current levels of uncertainty. Obviously the decision to delay can have associated costs. An option theory approach attempts to balance the value of waiting for the uncertainty to reduce against the cost of making the decision now, within the current time-frame. The definition of time-frame is highly independent upon individual business sectors.

4. A brief introduction to Options Theory

Options theory provides a formula, which allows us to model and evaluate decisions that are:-

- Uncertain,
- Irreversible
- And delayable

Although numerous formulas exist, undoubtedly the best known and most widely utilised is the noble-prize (for economics) winning formula of (Black and Scholes 1973). This formula gives the value of a call option as:

$$C = A.N(d) - S.N(d - \sigma\sqrt{T})e^{-rT}$$

where

$$d = \frac{\ln(A/S)rT}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

and,

- C is the value of the call option. This can be regarded as the change in value because of the delay, i.e. deviation from the expected NPV value. Hence C is either 0 (option not exercised) or A-S (value minimised) in an ideal setting.
- A represents the value of the expected revenues from the operational project.
- N() is the cumulative standardised normal distribution function.
- S is the strike price, or the price that the option holder agrees to pay if they exercise their right to purchase the option. This can be regarded as equivalent as a cost (against time of delay) function within our domain of interest.
- the symbol σ represents the volatility of A. This is normally defined as the standard deviation of A; and represents the systems ability to re-evaluate options during the duration of the delay period.

- r is the risk free interest rate. Usually defined as the rate of return on treasury bills or bonds within the country of operation.
- T is the option's time to maturity, i.e. the maximum length of deferral or the number of time periods.

This paper believes for the three reasons stated at the start of this section, that this type of options model represents a better basis for decision evaluation rather than the traditional NPV approach.

5. Limitations of Option theory approach

Like all modelling approach, options theory has a number of underlying assumptions, which may limit its application to certain e-commerce projects:

- In the above simple model, it is assumed that present value of the expected revenues from the operational project are not negative. This condition is unlikely to occur, unless the project has a risk of, for example litigation. More complex models can model this issue.
- The expected revenues from the operational project are expected to have a parametric form. If not, then an accuracy description of the underlying distribution is difficult to achieve. Hull (Hull, 1993) provides commentary on how to interpreted the call price when the expected revenues are poorly defined.
- The standard Black-Scholes equation (as described above) is difficult to solve on or before its expiration. Hence, often an approximation must be deployed. See (Macdonald and Siegel, 1986) for one method of resolving this difficulty. Obviously, this approximation is less accuracy that the original theory suggests.
- The standard Black-Scholes equation is assumes that the strike price is not stochastic. Dos Santos, (Dos Santos, 1991) has extended the equation to handle these situations, but the solution of this extension requires knowledge of the correlation between the strike prices and the expected revenues from the operational project. Unfortunately, this is not generally known; and hence the application of the Black-Scholes formula is problematic under these conditions. Other alternative option pricing modeling may perform better under these conditions.

6. Conclusions

E-commerce is a new and exciting domain that is still under development and as yet not fully explored. For those involved in this business there is relatively little underlying theory or details of best practice to guide decision-making. Most decisions in this domain can be characterized as having a high degree of uncertainty, delayable in terms of time to market entry, and irreversible - with finance committed at the start of the venture not being redeemable until the venture is brought to maturity.

Traditional economic approaches to modeling such decisions (such as NPV) are incapable of successfully handling information with these characteristics. Hence there is a need for a new approach in modeling this type of decision. Option theory, commonly used within the futures and other derivatives security sector, as well as with general corporate finance, can incorporate all aspects of these three characteristics. It is the belief of the authors that options theory could provide a new and exciting approach to modeling and evaluating design and deployment decisions in the e-commerce sector.

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Using Multimedia Courseware to Bring Together Theory and Practice

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Abstract: This paper describes the implementation, use, and evaluation of courses utilizing multimedia courseware to bring theory and practice together as a pedagogical strategy. In particular, we will examine how courseware originally developed for use in a university distance education course in interface design was utilized with in-person courses in innovative ways. The courseware helped facilitate self-expression, enhanced seminar style interaction, and aided the exploration of the learning processes by learners themselves.

Introduction

There have recently been new theories in education which place the learner at the center of the learning process--a challenge to previously dominant ideas in educational practice. These ideas are conceptually based in theories of situated learning, collaborative learning, and/or constructivist approaches to learning. This represents an important movement in educational research in the area of educational technology and technology-mediated learning such as using courseware at the university level.

This paper describes the implementation, activities, and evaluation of courses utilizing multimedia courseware. In particular, we will examine how courseware originally developed for use in a university distance education course in interface design was utilized with in-person courses in innovative ways. The courseware helped facilitate self-expression, enhanced seminar style interaction, and aided the exploration of the learning processes by learners themselves. The software, Interactive Online Seminar, was designed to support and encourage independent creation and feedback as well as collaborative seminar-style interaction.

During the development of this courseware, I taught Digital Arts and Theory in the Department of Media Study at the University at Buffalo (UB), New York's largest public institution. Course size was generally under twenty-five students per class—a bit more in discursive, critical, or theoretical courses, and less in production courses. In-class interaction tended to be higher when there were fewer students in the room.

Many university art and media courses have difficulty integrating theory and practice. Susan McKenna notes, "there is a widely held assumption in art teaching that theory gets in the way of creativity and spontaneity" (McKenna 1999, par 1). When I arrived at the University at Buffalo in 1997, I was slated to teach one theory course and one practice course. I believe these two aspects cannot and should not be separated into different courses, and I am not alone in this thinking. Occasionally media or art departments do try to integrate some readings into practice or production courses; this happens much more frequently than does the integration of practice into traditional theory or history courses. But often the large number of students in a theory course prohibit any "hands-on" learning or creative self-expression, particularly in the field of computer graphics, when many hours of instruction is required to bring students to a level of competency. In this paper, I will show how multimedia courseware enhanced student learning and interaction in the critical courses "Gender and Technology" and "Cyberculture and Technotheory."

Courseware.

A variety of courseware packages were reviewed before implementing the courses we generated the comparison by hands-on user testing while producing a demo course on each system. WebCT and CourseInfo (BlackBoard, Inc. now owns CourseInfo) were most closely surveyed. Site administration was fine in both of these packages. WebCT's strength was the ability to customize the courseware to each student individually. CourseInfo sites had easy to understand navigation model, although it took up a lot of room on the screen. WebCT did not display headers or footers and had uneven navigation model, but then had a very good way of monitoring student behavior online and assessing success. WebCT also had an interactive whiteboard, but it was not tied to other areas of the content online. Thus, through our review, WebCT had the right features but the organizational model lacked in one important area: to use student creative work and images as the organizing feature of the course, much like it is in media production courses.

The Software.

Integrated Online Seminar (IOS) software was created to facilitate distance learning needs, specifically for a seminar style environment, that could not be met by other packages, email, or chat. IOS was created to foster a participatory feel for an online classroom experience that encourages an interesting, creative and interactive session. Kaye argues that the inherent pedagogical characteristics of computer mediated communication are independent of whether it is used in a distance or on-campus environment and that these characteristics are:

1. computer communication is essentially a medium of written discourse, which nevertheless shares some of the spontaneity/flexibility of spoken conversation

2. computer communication can be a powerful tool for group communication (1999, 10).

IOS was designed to initially meet the needs of the Advanced Multimedia Design Seminar, a course taken by seniors and graduate students in illustration, graphic design, and multimedia at UB in 1997. The class participants needed to be able to share their graphic and multimedia work and interact with the work of other students. They had to be able to contribute and receive meaningful feedback frequently. Since the students were advanced, the freedom for students to work asynchronously, have a record of their progress, and update their work was essential.

IOS consists of two applications: an administrator component and a student component. The administrative component is a database application that allows a class instructor to create record entries for courses, students, and projects. The administrative application can monitor the progress of a student. The second half of the IOS system is the web-based student interface. The web approach was chosen since it offered the flexibility for cross-platform operation and for allowing students submit their work from both school and home. The IOS system utilizes Java Servlets (Davidson 98), which can be described as server-side applets, for tasks such as accessing database information and for facilitating uploading by generating HTML content pages so the student is free from the FTP process.

When a student participates in an IOS session, he or she is presented with a link-based navigational interface that allows for the selection of a course, student, and project. These navigation pages are dynamically generated by the servlets. When the student visits a project area, the interface appears as several frames which allow different areas for menu items, multimedia content, and text-based comments and discussions. The student then has the option to browse, post a comment, or submit multimedia content. The system is password protected so that only class participants can post comments, and only the owner of a particular page can submit content in his or her own area. All student comments are tagged with the poster's name and the time of posting on the server so the instructor can monitor use of the pages and events such as multiple postings by a single student, the time of posting, and other details. The courseware allowed the uploading of images, sound, html pages, shockwave movies—practically any type of digital media. This meant that assignments could incorporate some or all of these elements.

Effective Elements

Using conventional teaching methods, learning in media theory courses is traditionally achieved through reading and class discussion. Using online courseware as a supportive element to the classroom experience adds a new dimension to learning.

According to Pritchard, Internet classes are, in many ways, far more intimate than a traditional classroom. "Participants expect more personalized responses, personal attention, and individualized experience. The instructor has to live up to those expectations with timely and accurate responses" (Pritchard 1998). So do classmates. In these courses, we incorporated both in-person and online interaction, which took significant time and effort. In online courses, newsgroup-style interaction, or discussion threads, can be vital learning areas if the instructor encourages (and enforces) their use. But I wanted to rearrange the idea of threads and make the student's ideas-- their responses to the critical readings in a media theory class-- to be the guiding discussion elements for the course. The instructor interacts on a peer level with the other students to pose questions to individuals and groups at the site of a particular work.

Students in every class taught with IOS facilitation came from a variety of backgrounds and with widely varying degrees of knowledge about computer graphics. Some of the students had literally never saved a file, while others were graduate students in the media production MA program. All students had to complete writing assignments, but for three exercises, students could choose to write a paper or create a work that manifested the theory behind a particular reading or discussion. This choice created an environment wherein theory students could try out HTML to create a manifestation, and those who were already media savvy would at times write or combine text and image in collages, videos, etc.

Courses Facilitated by IOS

In Fall 1998 and Spring 1999, I surveyed a total of 42 students taking part in critical courses, "Gender and Technology" and "Cyberculture and Technotheory." In response to the survey, 35 out of 42 students responded. Comments described how the courseware "allows access to other people's work without having to make a million photocopies," according to one student. Over 25 percent of the students commented in surveys that the best aspect of the project was that they could upload and discuss visual content, see and talk about the work of their peers, and "get ideas from each other" in an arena outside the classroom.

Evaluating the System

Over the two years it has been used, the system's user interface and additional aspects have been studied through surveys, interviews, and usability testing. Server usage patterns have also been tracked in order to correlate them with user's actions while using the system. In order for this application to be useful, it had to combine technological advances with sociological models to support co-dependent work (Grudin 1991).

The Interface Design

The interface was the primary site for testing the IOS system. The system design required that a student navigate from course to student and then from student to project in order to view submitted content. The reason for the original design was to create a uniform navigational space and to create a strong relationship model between the class components.

The concerns students had with the interface was not the navigational model but with the "posting" procedure. Out of the 35 students surveyed, 91 percent of the students saw the interface as "easy to use," but the survey also uncovered 31 percent—almost one third-- of the users had trouble with naming conventions when posting their files to the system the first time.

The Content

As a course shell, IOS has little content except that generated by its users. The organization and manipulation of the content is an important task of the courseware. IOS has two ways to provide unique and variable access to content: a portfolio mode, which organizes the navigation into particular "student sets" (looking at work which belongs to a particular student), and a project mode, which organizes the navigation around a particular class.
One of the most important content elements in IOS is an interactive white board which allows the instructor and other students to draw on top of a student's work -the participants can draw, edit and change student images. This feature maps a color ink to a particular user and only registered users can participate. This assists media classes in particular since is often useful to offer suggestions to graphic work visually. The asynchronous whiteboard applet is used in conjunction with the IOS system. The comments layer is be superimposed on the original submitted work. Follow-up comments can either utilize the original media image or a combination of previous layers when formulating a response. The actual whiteboard application provides simple editing tools such as lines, fills, colors, and arrows.

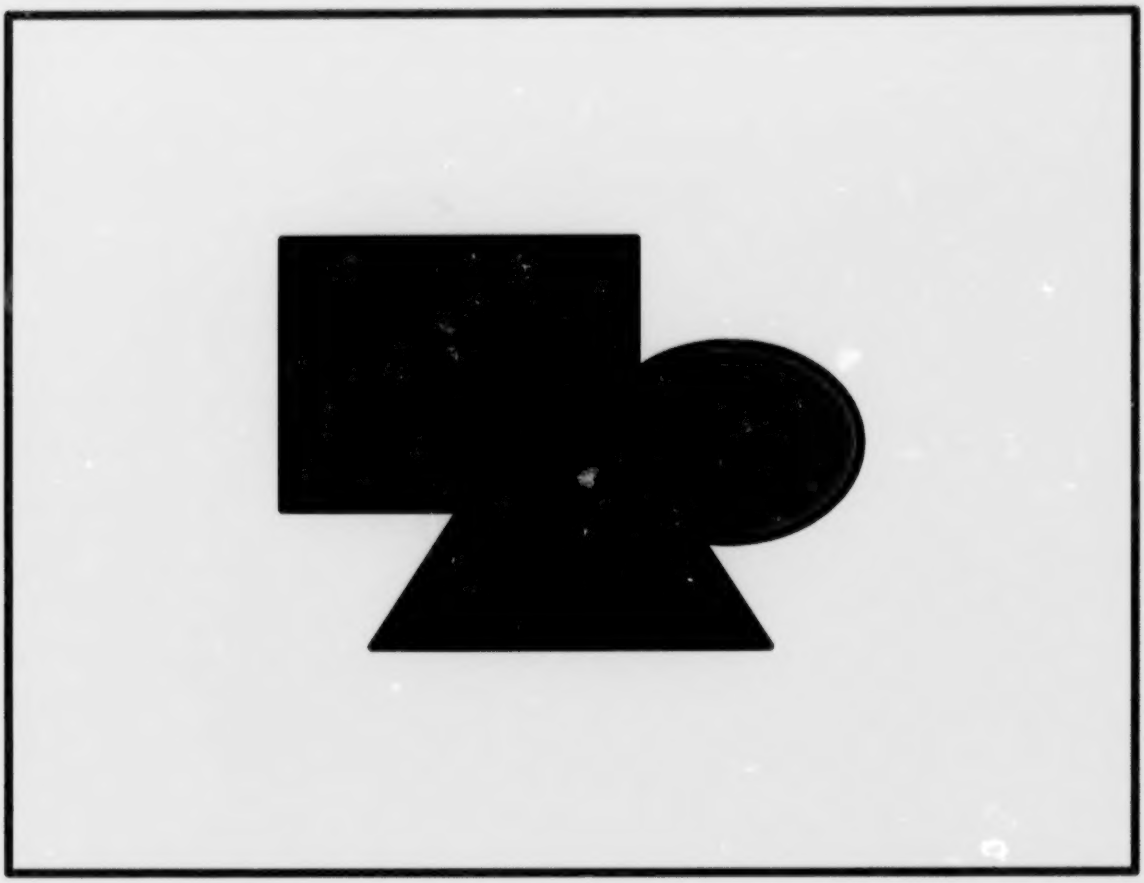

Figure 1. ***Fractals for Hal*** **Produced in "Cybertheory" course, University at Buffalo, by Aya Karpinska**

Theory and Practice

How does this technology-enhanced online seminar model support learning through theory and practice? Students are experimenting with visual and symbolic principles within a theoretical context. In fact, research by Nicholls, Nelson, and Gleaves shows that the older the student, the more the student prefers discussion of information as a learning method to develop personal stances on controversial or abstract issues (1995). What the students produced was generally thought provoking, interdisciplinary, and moving. A visually poetic treatment of HAL, the representational robot-ship from *2001: A Space Odessy* (Figure 1.) with a fractal generating other types of more "human" words next to the poem. It is a moving, dynamic work and through its dynamism it plays out "old-fashioned" ideas of what is human (the fractal, the generative, the natural, the live) versus text (the analytical, the updateable, full of form and function). Students manifest ideas through visuals, animations, code, audio. This approach is in line with other art educator's thinking, but uses technology to facilitate such diversity. According to McKenna, these kinds of assignments "can change the hierarchical terms of the classroom, as frequently a student hesitant to engage in a discussion will bring in strong visual work that demonstrates an application of the theoretical material" (1999 par 10).

And in the broader spectrum of education in the digital age, the integration of visual media has become essential across all learning (Bailey 1998). The role of arts in education thereby becomes more necessary. Long-time visual arts theorist Rudolph Arnheim has argued that "courses in drawing, painting, and sculpture, rigorously conceived, pose cognitive problems every bit as challenging as those found in mathematics or science classes" (Brewer 1998 par 7). In addition, Murfee notes that the value of arts education has been firmly grounded in theory and research with evidence that details a strong link between learning, knowing, and the arts (Murfee 1997).

Knowledge in both theory and practice areas is enhanced through interactive communications such as group discussions, seminars, and projects. The very learning process designed into the courseware offers results: student creative work becomes the product of interaction and discussion represented through the interaction model and thus becomes informed by theoretical and critical discussions. When promoting technology as a tool for active learning, Professor Stephen Heppell, an online learning researcher and head of Britain's UltraLab, suggests it is important to focus on how students learn with technology, and this is in line with the interaction style of a seminar which focuses on human interaction, debate, and active problem solving—the "getting ideas from each other" aspect of the software (Levis 1999).

It is an important educational strategy to utilize the arts in teaching across the disciplines; with courseware, all disciplines can open to a more interdisciplinary approach in the classroom to bring together aspects of theory and practice in unique ways. In the end, the results of student work show a strong influence from the group interaction fostered with the courseware. This is part of the power of the system, because using the system encourages the students to interact and think about the each other's concepts and critical ideas. Students also receive quick feedback on their own work and can incorporate critical issues brought in to the discussion—a model theory and practice environment. The courseware enabled the participants to record critiques, talk about work in an asynchronous environment (which some students reported was less stressful than discussing work in class), try testing theoretical ideas in creative work, and utilize a wide range of tools and techniques to access their ideas.

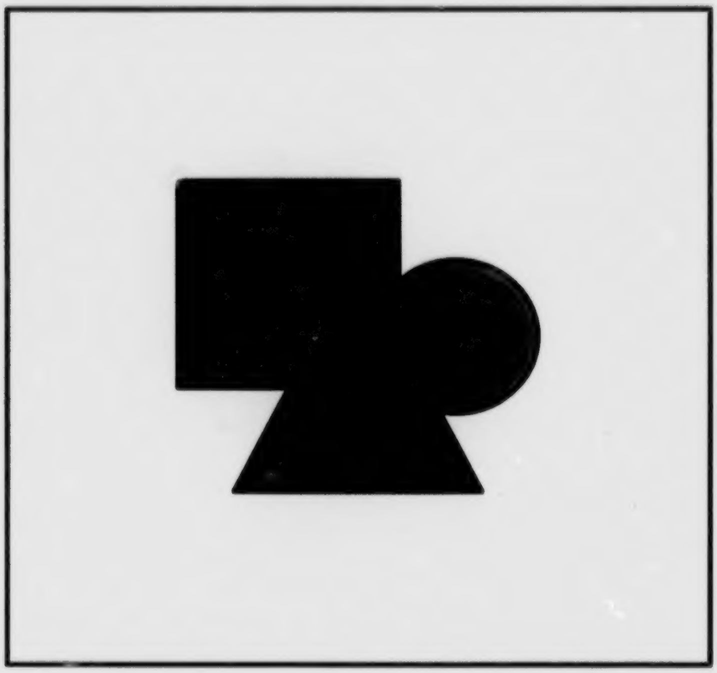

Figure 2. A page from the courseware showing a student's visual interpretation of future bodies. Below the image other students participate in discussion.

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Interfacing Differently:
Educating Girls in a Changing Digital Landscape

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Abstract: Girls keep up with boys when it comes to using computers for activities like surfing the Internet and sending e-mail (Cook 2000). But girls are underrepresented in growing areas such as computer classes and degree programs. The need to have better software, and educational software, for girls is clearly evident. This paper explores the concept, the learning models, target audience, technological approach, and project goals of *The Adventures of Josie True*, a web-based software project for girls age 9 - 11 designed to encourage exploration and promote confidence in math and the sciences in a multicultural, educational environment.

Introduction

Recent changes in the girls software industry such as the commercial success of the Barbie software *Barbie Fashion Designer* and the subsequent Mattel takeover of software company Purple Moon have left parents and software developers in a bit of a conundrum. Clearly, games for girls are a market just beginning to be tapped. Yet underlying this market potential lies the not-so-subtle fear that girls must be sold or given only certain kinds of content in order to succeed in their market. Recent releases from Mattel, Hasbro, and Simon & Schuster still play to stereotypes about what girls want: Barbies, makeup, makeovers, fortune telling, sleepovers, boys, and dream analyzers. Not one commercial release for girls has been an educational product. How can scholars and multimedia designers respond to this situation? If there are no products on the market, it is impossible to demonstrate market demand. Yet the need to have better software, and educational software, for girls is clearly evident. Girls do keep up with boys when it comes to using computers for leisure activities like surfing the Internet and sending e-mail (Cook 2000). But girls are underrepresented in growing areas such as computer classes and degree programs. In response to this great need, we received a grant from the National Science Foundation's Program for Gender Equity to fund just such a project.

The Adventures of Josie True is web-based software for girls age 9 - 11 designed to encourage exploration and promote confidence in math and the sciences in a multicultural, educational environment. Using an adventure game as the premise, lead character Josie True becomes involved in intrigue across time and space as she rescues her inventor-turned-teacher Ms. Trombone. During their travels, girls meet innovative women from history who serve as multicultural role models. In addition to exploring rewarding activities based on science and math curricular topics, girls are able to learn about women's history through technologies that allow girls to "interview" women like Bessie Coleman, the first female African-American aviator.

Project Goals

The project was motivated by a desire to improve all girls', but especially disadvantaged girls' overall aptitude and attitude towards science, math, and technology. The web-based educational materials were built to support active learning and women and girls' learning styles useful in achieving the following specific goals:

- Increase the students' comfort level with technology
- Increase the amount of time girls spend using technology
- Improve learning by contextualizing concepts/problems in a narrative to make abstract problems "real"
- Provide content that girls can identify with: a female Asian-American hero, historic characters, and heroes of color
- Change perception of role of science, math, and technology to promote associated fields of work

- Improve skills in 5th grade science/math curricular areas (Craig&Stewart 1997)

Studies of the 17 most popular-selling mathematics software packages have shown that the programs are filled with violence and promote competition against peers. Further, the number of female characters and voices represented in products decrease with target grade level (Chappell 1996). In addition, researchers have documented that girls like computers, but they don't necessarily like the software designed for boys (Thomas 1996). Our goal for this project is to give girls educational software that matches their interests and builds project objectives in a positive manner.

Target Audience

Susan Herring has found invariably in her studies on gender and computer use that online communication is male-oriented and dominated by the use of assertive language and confrontational approaches (Herring 1994). On the contrary, according to Pearce, the World Wide Web has become a "playground for women and girls" as it emphasizes content, writing, and correspondence (Pearce, 1997 214; 10). But women's' technology skills lag behind the skills of their male counterparts (AAUW 1998). In 1997, the number of females using the Internet was almost equal to the number of male users. Over 40% had used the Internet at home or in the office during the last 30 days, and 47% of women surveyed had access to the Internet through home or work (Gersch 1998). Access, however, is different than usage time. In the Times-Mirror and SPPA surveys of 1997, boys who use computers at home give weekly usage estimates that are 20 percent higher than girls—boys still spend more time with the computers (Littleton et. al. 1993). We are specifically developing this educational software to attract girls to extend the time spent using the computer.

While the number of African-Americans and Hispanics owning PCs is steadily growing, it is still less than the number of whites with ownership and access (Hall 1998). Yet software content is not diversifying to reflect users from different cultural and economic backgrounds. *The Adventures of Josie True* is designed to fill this gap and appeal to 9-11 year old girls from a variety of ethnicities and backgrounds. While researching multicultural science education, we have consulted many studies, among them the 1994 Community Resource Curriculum Development for Grades 5-6. This curriculum, developed by M. Bentley et al, encourages children living in a city to explore their surroundings through science (1994). This plan outlines ways to develop multi-ethnic, multi-cultural science units. The authors note that it is important to use skills students have gained from their own lives in hands-on investigations and experiential activities. Subsequently, they created units concerning human flight, sound, and "Weather in the Windy City" which explores Chicago's weather. Inspired by these units, we chose Bessie Coleman as the lead role model for this software. By presenting a woman innovator, pilot, and successful woman of color who struggled to get her pilot's license during a time of segregation and intense discrimination, we show that science principles aren't just found in school or the laboratory. Being a pilot, Bessie Coleman had to learn a broad range of science and math principles in order to follow her dreams. She was fluent with the technologies of her time, and as a role model demonstrates the practicality and the applicability of such principles in everyday life. Wyatt notes that reasons for the lack of women in science-related fields include the lack of female role models, girls' underdeveloped spatial visualization skills, and learning styles incompatible with the methods practiced by men (Wyatt 1993). In addition, numerous scholars note that by the time girls are of junior high school age, they need to know that history includes women, and they need more examples of women who are strong and more female role models acting in a variety of roles (Orenstein 1995; Pipher 1994). It is appropriate here to note that while the software discussed is geared towards girls, it may also appeal to boys. Female role models and new models of game interaction may be attractive to some boys as well, and if the project appeals to this audience, it will be welcome attention.

The software industry's service to girls has recently become more negative than positive. First off, there are few if any commercial educational products directed at girls. Software targeted towards girls has not focused on educational material, as there is a push to simply get girls interested in the computer before "making them learn."(Thomas 1996). We can, however, look at off-the-shelf software made just for girls as part of a survey of "what's out there." The only commercial software developer interested in providing girls alternatives to titles such as Mattel's "Barbie" series (Purple Moon) recently was purchased by Mattel itself. In addition, the "edutainment" industry has avoided girls of color. Neither the entertainment nor the educational software makers are providing a minority cast of characters and promoting science and technology as fun, interesting areas of study. This situation is desperate. While there are several girl's CD-ROM titles out on the market today, none thus far address educational issues, technology, science and history education, or multiculturalism rooted in real role models as central themes, and only one provides mentors in science and technology..[1] Through media products, culture has constructed "girls" as a category that cannot enjoy learning.

Curricular Areas

The project's educational content is grounded in the standards provided by both the National Council of Teachers of Mathematics (NCTM) and the National Research Council (NRC) for Science and Mathematics education. Standards are selected for the 5^{th} grade level. Activities and subject areas have been chosen which emphasize the fifth grade curriculum. They feature educational activities which focus on a variety of NCTM- and NRC-supported science and math curricular areas: temperature, problem solving, light and melting point, chemistry, mapping/directions, a variety of mathematical exercises, an engine/construction exercise, a geometry/flight game, and a cloud-seeding activity. In all, these activities are a large portion of 5th grade science curriculum (Flanagan 1998).

In choosing curricular areas to explore in the software, we relied on the NCTM and NRC as well as focus group testing and educator input. Teachers have been found to overlook girls in the classroom, and our educational system discourages girls from pursuing math-related careers in proportion to boys (Wolf 1998;AAUW 1995,1998). Numerous studies (AAUW 1995,1998) show that girls are ignored or stereotyped in curricula and gender bias is found in academic activities and standardized tests. Because we hope to improve girls' performance and self-esteem in relation to the academic activities, specific problematic curricular areas were essential to include. The areas below represent the on which this project specifically focuses.

Primary Science and Math Curricular Areas
Math: Time, Distance Equations; Simple Machines, Fractions/Combinations, currency conversion, Coordinates, Problem Solving, Fractions; Science: Acid/Base and Litmus Testing, Simple Machines, and Currents/Circulation via piping and electricity; Weather, Light properties, Classification; Geography: Directions, Mapping
Secondary, Complimentary Curricular Areas
Communication: Build a Radio, Communication; History: Women's History, African American History American History, European History; English: Glossary

Pedagogical Motivations and Learning Models

Our pedagogical motivation was to develop online activities that promote confidence-building in math, science, and technology through active learning, anchored learning, and constructivist models. Active learning models require us to see how the design of the software offers transformative experiences in areas such as problem solving, evaluation, creating concepts, and analysis of information presented (Tuttle 1997; Dodge 1997). There are two types of interaction designed into the software: time-based (via the narrative) or non-time-based manner (interactive journal, online scrapbook, interview area.) Both provide excellent opportunities to enhance active learning, but the majority of collaborative project-based learning in the program happens in the non-time-based areas such as the online scrapbook. To promote multicultural education, we are emphasizing culturally relevant curricula. According to Nelson Ikegulu, true multicultural learning can take place if the curriculum relates experientially to the cognitive, academic, social, and linguistic abilities of students (1997). Using this foundation, we believe that four strategies fit into both of these models. First, we provide temporal, activity-based learning that is driven by narrative (Campbell 1996). Second, we provide a-temporal spaces for learning and collaboration, such as the interview area and the journal. Third, we offer online and offline activities to help bridge the gap between technology, access, and daily life. Finally, we offer online activities in conjunction with a girls' computer club where girls can participate in community building, collaborate on their own creations, and use their learning in another context. This software engages students inside and outside of the classroom, thus promoting active learning through the use of e-mail, software, and the investment of time when using the software (Gillette 1996).

We are relying most on Schank and Cleary's "teaching architectures" (1995) which combine several models that can be used to attract middle school minority girls to math and science (Taylor Anderson 1993). The authors have developed "teaching architectures" which overlap several other learning models and are useful to the design of such an interdisciplinary software project (Lonergan 1997). This model consists of five areas:

Simulation -based Learning by Doing	Offers students the chance to learn by "doing." Also involves active learning. Environments that encourage active learning are based on learners making decisions about task, content, navigation, presentation, and assessment. Active learning environments make use of a number of cognitive strategies that enable the learner to elaborate on their own existing knowledge structures (schema), in other words, to construct new knowledge and understanding (Dodge 1997). Active learning provides

	represents the natural complexity of the real world; presents authentic tasks that conceptualize rather than abstract information; provides real-world, case-based contexts; fosters reflective practice, and enables context and content dependent knowledge construction. Middle school teachers cite that the reasons to use multimedia in science education are to increase student motivation and build self-esteem (Solomon 1991). *Josie True* situates all activities as 'real world' activities that can be solved.
Incidental Learning	Learning facts "naturally" by engaging in interesting tasks whose outcomes are educational. In *Josie True*, facts are imparted "almost covertly" through the adventure game context. For example, Josie needs to change her American dollars to Francs when she goes to France. If the problem took the form of a word problem in a book, it would not be as enjoyable. Girls had higher rate of success in a fraction game than doing the same problems on a static, "handout-looking" website."
Learning by Reflection	Learners construct their own meaning through reflection in journals. Girls can experience the content in several ways as it is not criterion-referenced (Dept Ed. Research 1997). The interview section of the game (where students can ask Bessie Coleman questions) encourages reflection, as well as the journal element. Using the journal, learners construct their own meanings and interpretation. Throughout the software, tasks and content provide several alternatives for learning, and evaluation can be performed in several ways as it is not criterion-referenced (Ntn'l Cntr Ed. Statistics 1997).
Case-based Teaching	Learners have a base of resources created for them within the software such as a database to look up concepts or facts presented. This information can be sought whether the student needs help or is just curious. In *Josie*, we are providing a database of such resources.
Learning by Exploring	Girls utilizing *Josie True* can explore the variety of areas available in the software because it is designed as an environment. They can also ask questions in a number of places and look up facts. Exploring in the software was an important gender difference in preliminary focus group studies. Several preliminary focus groups for this project showed us that girls using game software were more likely to explore the software at a leisurely pace, while boy users were more likely to click through scenes to finish or win the experience—even if the software was not designed to be a point-to-point game (Flanagan 1998). Miller notes that collaborating, rather than competing, and providing rich, believable environments are successful in getting girls interested in technology (Miller 1996).

The use of multimedia in science education also acts to link traditional disciplines together (Lonergan 1997). Students often acquire research skills, writing skills, mapping and geography skill, and/or math skills during what would be considered a more traditional "science" game or project.

Technology Strategy: Web-based Framework

While this media form may be appealing, questions immediately arise about access to technology. Significant barriers to the web's adoption still exist, especially in the K-12 arena. The "Survey of Advanced Telecommunications in U.S. Public Elementary and Secondary Schools" gathered data from 911 schools and showed that while in 1996 only 77 percent of schools had internet access, by the year 2000, 95 percent of schools expect to have access (Heaviside & Others 1997). There may still be a limited number of machines per school, however, and access does not guarantee that poorer schools will have enough computers or that they will have computers able to adequately run internet programs. Thus the goal in the technical development of the project was to provide for a wide range of access possibilities and to make the technological apparatus as transparent as possible through load times (program speed) and robust design. The web is primarily a visual interface and thus designing the navigation structure for the most diverse audience possible is essential. Visual navigation cues, clarity of design, and access speed strongly affect a user's response to the software (Rajani & Rosenberg 1999).

According to Brunner, if technology is introduced as an end in itself, young women are less likely to be interested (Brunner 1997). Thus we have focused on the unique content and open access to the program. The software can used both locally (off the hard drive or CD-ROM) or remotely (off the Internet)—a great advantage to the technological approach over strictly CD-ROM (Walley 1995). Web-first solutions make the most sense for educational technology, but porting retroactively to technologies such as CD-ROM may very well be the reality for projects targeted towards large audiences composed of many classes and geographies since schools are still poorly equipped. The key is upfront planning. We can produce simultaneous Web and CD-ROM projects by pressing the web to CD-ROM. In reviewing a variety of approaches to the technical side of the game, we used a wealth of tools and tests. They included animation with Macromedia Flash, DHTML, and Java Applets complete with behavior atributes. We decided to use Macromedia Flash and write all of the game script in this program, meanwhile being concerned to make load time as transparent as possible and to make the work as accessible as possible (Furger 1998).

Differences in Approach

Why is such a project different from other projects for girls? It differs in the educational content and in the incorporation of real girls in the early planning stages of the project. Only a few other projects such as E-GEMS (http://taz.cs.ubc.ca/egems/) at the at the University of British Columbia tackle this area of educational software for girls in science and math. Budgets are limited, and the platforms of the projects are usually difficult to distribute (CD). *Josie True*, with an emphasis on accessibility via the web, can address the distribution issue somewhat. Further, while E-GEMS offers great games, they are not large adventure games with a complex cast of characters. *Josie True* offers the ability to play discreet games or get involved with an overall adventure. We also felt strongly that frequent contact, through usability testing, concept testing, or general "tech talk" meetings with girls in the target age and economic group was essential, and worked with several local schools including a public Montessori school.

Conclusion

In the January 2000 release of the *Communications of the ACM*, Gorriz & Medina rely on a market analysis to justify the "new" interest in games for girls (2000). Yet market research only touches on the real root of the problem. We need to create projects for girls to address girl's learning preferences first as a pedagogical issue, not prioritizing the market value of girls' dollars. The need for educational software for girls has never been greater. There is currently an unsatisfied national demand for people trained in information technology (IT), and a critical labor shortage in IT areas is likely in coming years (Widnall 1988; Task Force Women, Min. 1988). The statistics show that only a small percentage of the students enrolled in IT programs are female, and that contrary to popular belief, the number of degrees awarded to women in the computer and information sciences peaked in 1986 and continues to fall (Ahuja 1995; Frenkel 1990). Thus one way to help satisfy the national demand in IT would be to encourage more women to enter the field. We plan to widen opportunities and enable and encourage the participation of women in IT fields by starting early with this adventure game.

We anticipate that *The Adventures of Josie True* will increase the number of girls entering and staying in math and science-related courses, clubs, and later, careers and fields. More information may be obtained at http://www.josietrue.com.

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[i] One exception: Cascade Pass, Inc's *You Can Be a Woman…* series featuring Astronomer, Engineer, and Marine Biologist.

[ii] Based on detailed classroom study of 10 girls age 9 - 11, the Josie game side-by-side with the "handout" web page.

A Visualization System using Data Mining Techniques for Identifying Information Sources

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Abstract: The World Wide Web provides great opportunities for serving as a repository of knowledge, yet presents great challenges in accessing this knowledge. Limitations of current search technologies are well known and include shortcomings in information filtering and authentication of sources. Recently, data mining and information visualization techniques in Web search have provided new tools to complement conventional search methodologies. The Visual Analysis System (VAS) was developed to couple emerging successes in data mining with information visualization techniques in order to create a richly interactive environment for information retrieval from the Web. VAS's retrieval strategy operates by first using a conventional search engine to form a core set of retrieved documents. This core set is expanded by crawling from links in these documents to form a much larger set. The link topology of the larger set is then examined using data mining techniques to identify pages likely to be both relevant to the query and reliable as sources of information. Information visualization techniques are used to display the filtered set in a form amenable to the use of perceptual processes to filter and guide further user directed search.

Introduction

The explosive growth of the World Wide Web has created a critical need to automatically filter, organize, and assess the quality of information so that users can efficiently and effectively identify and assess information sources. The availability of commercial search engines provides users one means of accessing information on the Web. Though this may account for much of the Web's popularity, it hides many of the difficulties of effective information access. Searching the Web is difficult due to size, diversity of data, and lack of a "quality assessment" scheme, to mention a few elements.

Though widely available commercial search tools are valuable assets to the Web searcher, it seems likely that these tools alone will not solve the current problems of information access. The challenges of information access on the Internet are issues common to all forms of information retrieval. These longstanding issues include difficulties in using indexing vocabularies, indexing indeterminacy, and the user's inability to completely specify information needs [Ingwerson & Wormell, 1986]. Retrieving information that meets users' information needs is an iterative process, and techniques which explicitly incorporate users' judgments, such as relevance feedback [Maron & Kuhn, 1960], provide means to automate some aspects of user guided retrieval. It is also clear that mechanisms providing alternative paths of access to information can enhance retrieval effectiveness [Bates, 1986].

Data Mining

Data mining refers to the analysis of typically very large data sets to reveal underlying structures or relations [Cios, Pedrycz, & Swiniarski, 1998]. The link structure of the World Wide Web represents a form of latent human annotation, and thus offers a promising starting point for structural studies of the Web. There has been a growing amount of work directed at the integration of textual content and link information for the purpose of organizing and searching in hypermedia such as the WWW.

Of particular interest for the problem of Web search is the recently emerging focus on the Web's hyperlink structure as a source of semantic information in the knowledge discovery process. Clever [Chakrabardi et al., 1999] is a search engine that analyzes hyperlinks to uncover two types of pages; "authorities", which provide the best source of information on a given topic, and "hubs", which provide collections of links to authorities. Research group developed an algorithm to compute the hubs and algorithms called HITS (Hyperlink Induced Topic Search) algorithm. Beginning with a search topic, specified by one or more query terms, the HITS (Hyperlink Induced Topic Search) algorithm applies two main steps; a sampling component, which constructs a focused collection of several thousand Web pages likely to be rich in relevant authorities; and a weight propagation component, which determines numerical estimates of hub and authority weights by an interactive procedure. Kleinberg and colleagues have continued to refine this basic approach [Gibson, Kleinberg, & Raghavan, 1998a; Gibson, Kleinberg, & Raghavan, 1998b; Kleinberg, 1998].

In addition to finding structural components such as hubs and authorities, hyperlinks can also be used to categorize Web pages. However, exploiting this link information is challenging because it is highly noisy. HyperClass [Chakrabarti, Dom, & Indyk, 1998] embodies one approach to this problem, making use of robust statistical models such as Markov using random fields together with a relaxation labeling technique. The methodology of influence weights from citation analysis is similar to a link based search method initially used in the Google search engine [Brin & Page, 1998]. The algorithm first computes a score, PageRank, for every page indexed. Given a query, Google returns pages containing the query terms, ranked in order of these pages' Page Ranks. It focuses on pages identified as "authorities", as in other work. Using a crawler, it searches for hyperlinks to other pages that are deemed relevant to the topic, based on text-matching and other techniques. Google ranks such pages highly and to return them in response to a search query.

Information Visualization

One promising approach for enhancing information access in large information spaces such as the Web is visualization to facilitate users' perception of document relation structure. A number of systems have been developed to provide visually based browsing mechanisms for traversing the link structure of Internet documents [McCahill & Erickson, 1995; Hendley et al., 1995; Munzner & Burchard, 1996].

Visualization has also been used routinely in data mining as a presentation tool to generate initial views, navigate data with complicated structures and convey the result of an analysis. Perhaps a stronger visual data mining strategy lies in tightly coupling the visualizations and analytical processes into one tool. Letting human visualization participate in an analytical process and decision-making remains major challenge. Certain mathematical steps within an analytical procedure may be substituted by human decisions based on visualization to allow the same analytical procedure to analyze a broader scope of information. Visualization supports humans in dealing with decisions that no longer be automated [Wong, 1999]. VANISH [Kazman & Carriere, 1996] is a visualization tool used in this way by supporting the easy integration of new semantic domains for visualization. It was used to implement an algorithm that supplements standard content only searches with structural information collected by a spider. After the query has been post-processed via three-step process, an information space is constructed from the neighbor set, suitable for visualization. It has the capability to visualize these information spaces structured as both graphs and trees.

The Visual Analysis System: Mining and Visualizing WWW Structure and Information Sources

The Visual Analysis System (VAS) was developed to couple emerging successes in data mining with information visualization techniques in order to create a richly interactive environment for information retrieval from the Web. VAS's retrieval strategy operates by first using a conventional search engine to form a core set of retrieved documents. This core set is expanded by crawling from links in these documents to form a much larger set. The link topology of the larger set is then examined using data mining techniques to identify pages likely to be both relevant to the query and reliable as sources of information. Information visualization techniques are used to display the filtered set in a form amenable to the use of perceptual processes to filter and guide further user directed search. More detail on VAS is available in [Karadayi & Fowler, 2000].

The Visual Analysis System is made up of several components. Initially, VAS receives a user's query as a keyword or keyword set. The system then submits the query to other search engines, such as Alta Vista, retrieving the best matches (usually 200) to serve as a starting point for VAS directed search. Visual Analysis System then starts its own search by following links in these pages to retrieve a second level set (typically 2000-3000). Links in these pages can also be followed to retrieve a third set of pages. Typically, pages retrieved in the second level set contains a large number of links to pages within the retrieved sets, as would be expected starting from a single query. As page sets are retrieved, a graph showing connections among pages is formed and displayed, as shown in Figure 1. This dynamically formed and displayed graph is the primary means of interaction with the system.

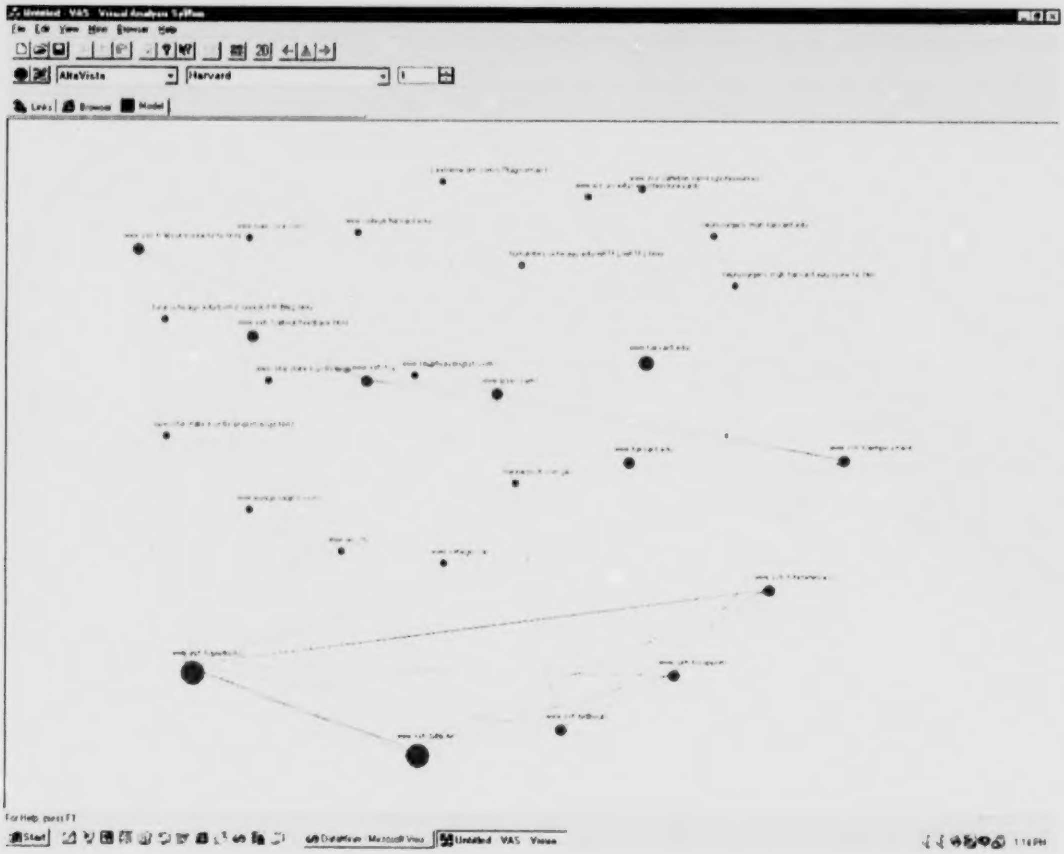
Untitled - VAS - Visual Analysis System
File Edit View Mine Browser Help
AltaVista
Harvard
Links
Browse
Model
For Help, press F1
Start

Figure 1. A typical Visual Analysis System Display. The 30 pages of highest authority found in a two level search are displayed. Size and color are used to indicate degree of authority and connectivity. Users can select

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a displayed document and go directly to the document while search and analysis continues. Users can also select to display hub documents.

Other researchers [cf., Kleinberg, 1998] have characterized pages as *authorities* (many links to the page), which provide the best source of information on a given topic, and *hubs* (many links from the page), which provide useful lists of possibly relevant pages. VAS first distills a large World Wide Web search topic to a size that makes sense to the human user: a means of identifying the topic's most definitive or authoritative Web pages. That is, not only a set of relevant pages is located, but also those relevant pages of the highest quality are identified. VAS exploits the fact that the Web consists not only of pages, but also hyperlinks that connect one page to another.

Just computing authorities and hubs in a query is insufficient, however, if the iterative nature of the information retrieval process is to be accommodated. VAS provides a dynamic visual summary of the systems data mining and search results for interaction. This enables users to get the information they need, make sense of it, and reach decisions in a relatively short time. It takes advantage of the human's natural pattern recognition ability by creating visual representation of the data mining results the system computes. By providing a 2-dimensional view, users can navigate through visual space to select and manipulate objects easily. Interaction with the resulting visualization allows users to focus their attention directly on the results of the query in an immediate and compelling way.

Determining the documents displayed to users as authorities and hubs is based on a graph theoretic analysis of the hyperlink structure of the page sets retrieved in the initial query to the search engine and subsequent crawling of links in the sets. Loosely stated, authorities are pages with many links to them (high in degree) and hubs are pages which supply many links to other documents in the same semantic domain (high out degree). Given any subset S of nodes, the nodes induce a subgraph containing all edges that connect two nodes in S. The algorithm starts by constructing the subgraph in which AVS will search for hubs and authorities. To construct the subgraph, the system first uses the query terms to collect a root set of pages, which is about 200, from an index based search engine such as Alta Vista. This set of pages does may not necessarily contain authoritative pages. However, since many of these pages are presumably relevant to the search topic, it is expected that some will have links to most of the prominent authorities. Now AVS can expand the root set into base set by including all the pages that the root set pages link to, and all pages that link to a page in the root set, up to designated set size. This approach follows the intuition that the prominence of authoritative pages derives typically from the endorsement of many relevant pages that are not in themselves prominent. Since links between two pages with the same Web domain frequently serve a purely navigational function, and thus do not confer authority, we need to delete all links between pages with the same domain from the subgraph induced by the base set, and then apply the remainder of the algorithm to this modified subgraph.

Giving a concrete numerical interpretation to authorities and hubs, we can extract good hubs and authorities from the base set. After these calculations, we can update the authority and hub weights as follows: If many good hubs point to a page, it increases its authority weight. Intuitively, the pages with large weights represent a very dense pattern linkage, from pages of large hub weight to pages of large authority weight. System outputs a short list consisting of the pages with the largest hub weights and the pages with the largest authority weights for the given search topic. A text based display, which is not shown, is available to the user to present this state of the analysis.

The visual representation, shown in Figure 1, is constructed by using a user-selectable criterion for the level of authority or hub to display to filter the complete sets, e.g., 30 highest ranked authorities in this example. Underlying link structure is used to position nodes, and size and color reflect authority, in this example, or hub rank. Connections are only shown when there is a direct link among pages displayed.

Acknowledgements

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Conclusions

For broad topics on the Web the amount of relevant information is growing extremely rapidly, making it difficult for individual users, and even individual search engines, to filter the available resources. To deal with this problem a way to distill a topic for which there may be millions of relevant pages down to a representation of very small size is needed. It is for this purpose that VAS uses the notion of authoritative and hub sources based on the link structure of the Web. The goal is to produce results that are of as a high a quality as possible in the context of what is available on the Web globally. For VAS the underlying domain is not restricted to a focused set of pages, or those residing on a single Web site.

VAS infers global structure without directly maintaining an index of the Web or its link structure. It requires only an interface to any of a number of standard Web search engines and uses techniques for producing enriched samples of Web pages to determine notions of structure and quality that make sense globally. This helps in dealing with problems of scale for handling topics that have large representations on the WWW. VAS discovers authoritative pages, and in fact identifies a more complex pattern of social organization on the WWW, in which hub pages link densely to set of thematically related authorities.

The results are useful from a number of perspectives. Analysis of the link structure of the WWW suggests that the on-going process of page creation and linkage, though difficult to understand at a local level, results in structure that is considerably more orderly than is typically assumed. Thus, it gives us a global understanding of the ways in which independent users build connections to one another in hypermedia that arises in a distributed setting. It also suggests some of the types of structured, higher-level information that designers of information discovery tools may be able to provide both for, and about, user populations on the Web.

Finally, VAS is user-centric, taking user's needs into account by allowing them to interact with the information contained in large numbers of documents. The visualization process is an integral part of the overall process. VAS focuses on visualization and visual interfaces in support of information retrieval and data mining.

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Cecil: An Enterprise Wide and Beyond Education Delivery System. Enticing the End-User – Reflections from Auckland, New Zealand.

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Abstract: Computer Supported Learning (CSL), or Cecil as we like to call it, is a university wide education delivery mechanism that supports the teaching, learning and administration delivery needs for the whole University of Auckland. The system's background, architecture, it's many faceted nature and the experiences of the developers and users are outlined in this paper.

Introduction

Computer Supported Learning (CSL) is an on-line education delivery and support mechanism (known by us as Cecil). Cecil has grown from small beginnings and bright vision over the last six years. It is a capable of supporting teaching, learning and administration throughout the whole process of a course, during the semester. Cecil is an amazing tool for the academic, the administrator, the student and also the strategic planner. This paper discusses the nature of this system and reflections on the uptake of these technologies in the wider academic domain.

Cecil Background

The University of Auckland is the largest university in New Zealand with some 26,000 students currently enrolled. It holds significant, broad-based intellectual assets that are of great national service as well as bringing our unique perspective to the world. Our post-graduate population is rapidly increasing, as is their need for systems designed to support life-long learning (Sheridan 1998).

Given the movement in education to modes of distance and technology based learning, the university looked to the future and began to build significant, innovative, and tangible projects. Cecil is one of these projects and represents a translation of a vision into a new, useful and extensible tool. It takes advantage of the Internet technologies to enable onsite and remote access while leaving the design open for enhancements as the Internet bandwidth allows.

The functional design for CSL came from an instructional staff with wide experience of different computer-based training systems. Combined with the advanced database systems and the latest software architecture, Cecil has been built for students, tutors, academics and administrators.

Educational Delivery Through Cecil

Cecil is a Computer Supported Learning System; this means it provides computer services to assist instructors in organising courses and providing resources to students over the Internet. Cecil provides services in four main areas: Course administration; online course material; Web-based testing; Instructor-student and student-student communication. The architecture and these service areas are briefly discussed next.

The Cecil architecture is classic n-tier consisting, currently, of a database (SQL Server), object layer (COM), web interface (Active Server Pages), and Windows thick client logical tiers. The object layer contains the business rules and is used by all presentation layers.

The database runs on a 4-processor system with a RAID disk array. The object layer and the web interface run together on a web farm (3 machines) that provides load sharing and redundancy. The design allows for the object layer to be placed on an array of object servers when required for increased scalability, (Fig. 1).

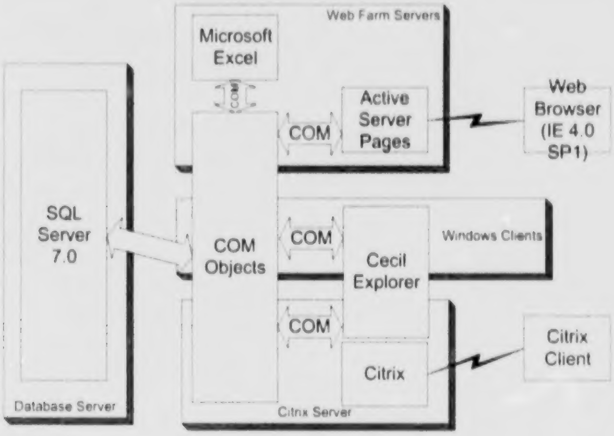
Web Farm Servers
Microsoft Excel
COM
Active Server Pages
COM
Web Browser (IE 4.0 SP1)
SQL Server 7.0
COM Objects
COM
Cecil Explorer
Windows Clients
COM
Citrix
Citrix Client
Database Server
Citrix Server

Figure 1. The Architectural Model of Cecil.

The thick client is deployed to users as a thin client via Windows Terminal Server or Citrix allowing a single point of deployment and access for users of any platform as well as through the web. This architecture, by using RAIS (Redundant Array of Inexpensive Servers), provides both linear scalability (cost vs. capacity) and redundancy to guarantee 24x7 service. (Fig. 2)

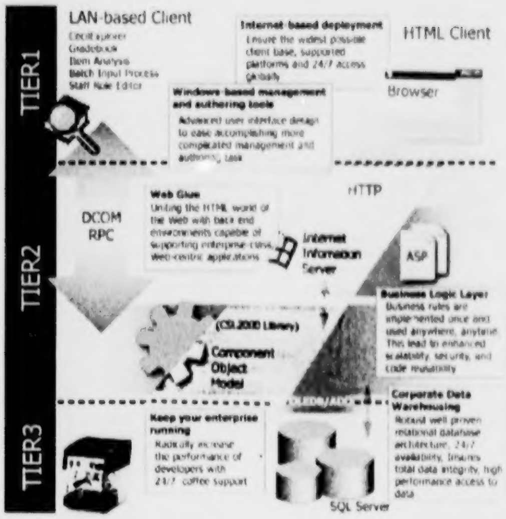
TIER1
LAN-based Client
Cecil Explorer
Gradebook
Item Analysis
Batch Input Process
Staff Note Editor
Internet based deployment
Ensure the widest possible client base, supported platforms and 24/7 access globally
HTML Client
Browser
Windows based management and authoring tools
Advanced user interface design to ease accomplishing more complicated management and authoring task
HTTP
TIER2
DCOM
RPC
Web Glue
Uniting the HTML world of the Web with back end environments capable of supporting enterprise-class, Web-centric applications
Internet Information Server
ASP
Business Logic Layer
Business rules are implemented once and used anywhere, anytime. This lead to enhanced scalability, security, and code reusability
(CS.2000 Library)
Component Object Model
TIER3
OLEDB/ADO
Keep your enterprise running
Radically increase the performance of developers with 24/7 coffee support
Corporate Data Warehousing
Robust well proven relational database architecture, 24/7 availability, Ensures total data integrity, high performance access to data
SQL Server

Figure 2. The N-tier Architecture of Cecil

In statistical terms Cecil has approx. 26,000 students currently enrolled. The Cecil web site averages over 1.5 million hits per week with an average of approx. 220,000 hit per day. It is understood from Ingram (1999) that a more accurate impression of the use of the system may be defined by looking at the visit statistics of the site. Here we note that our login statistics are an indicator of visits and find that daily an average of 1922 students login to the system. We can see from (Fig. 3 and Fig. 4) that the daily and weekly frequency distributions that the system is widely used throughout the whole week virtually 24 hours a day.

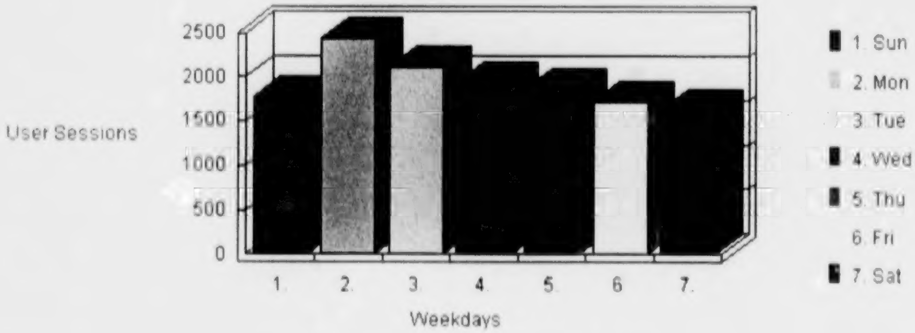

Figure 3. Activity level by Day of the Week.

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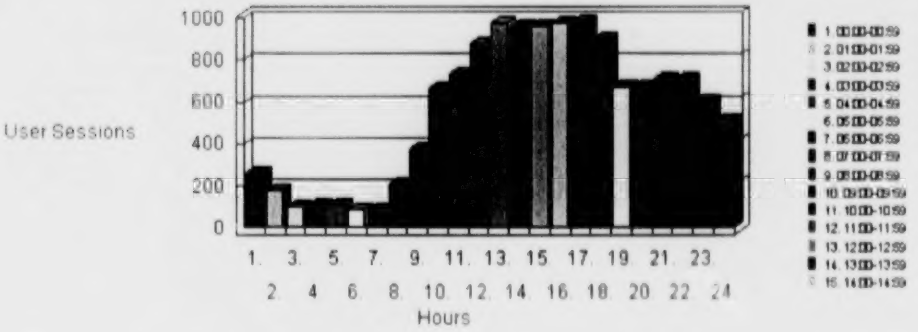

Figure 4. Activity level by time of day.

Cecil's foundation is a student records database that stores information about students, and their enrolled courses. The course team manages materials for papers and the administration of course activities. Individual course participants may check their progress through the web interface. Students' grades are entered on line either on-site or remotely. This reduces the administration required for large courses. With Cecil the marks are recorded directly into the database, reducing this administrative overhead and providing quick and comprehensive reports to the course co-ordinators. Of course Cecil provides instructors with a variety of essential reports on progress and automatically creates an examiners report for the end of semester (Sheridan 1999).

Course materials, of any electronic description, can be provided online through Cecil. This means that students are able to access this information 24 hours per day, and they don't have to come into University to get it. In some cases entire courses are taught using entirely online material, without lectures. In this case the provision of materials such as through Cecil is essential.

A key part of Cecil is its ability to perform online testing over the web. In semester 1, 2000 some 87,680 online test were delivered and marked by Cecil. The basic form of this is a number of questions presented sequentially to the students. Each student answers questions and then submits their test for automatic marking and feedback. Based on their results a feedback message is generated that gives the student pointers to gaps in their knowledge and provides references where this information can be found. Reports can be generated which aggregate and summarise the student responses that allow lectures to be tailored to focus on areas that have been less well understood.

Instructor-Student Communication

One of the most vital requirements of teaching is being able to communicate properly with students, and enabling them to communicate with the instructor tutors. Cecil has several mechanisms for facilitating excellent communication within a paper. These are: announcements, discussion groups, and online chat.

Instructors can make announcements through Cecil and also email them to the whole class. When students login to Cecil they can view the announcements for each paper. According to our records Cecil serviced 127,000 emails to students and staff in the first 6 months of 2000.

Integrated into Cecil is a premier web-based discussion server. Each paper can have a discussion forum. Students and staff members can post messages to this forum, and reply to previous messages. This enables instructors to answer student queries once, rather than once per student. It provides a means of group communication that doesn't have to wait until the next lecture or tutorial. For more real time interaction between instructors, students and perhaps external sources Cecil also has a chat server.

Supporting the University with Cecil.

In hind sight the endeavours of the system and the development team appear to be at a nebulous point in the uptake of these enabling technology by the University as a whole, however there are issues that are being addressed before this widespread use of the technology will occur. Cecil is technically robust and able to meet the predicted performance needs of the University however the issues lie with the end-users. Recognition of task, effort and risks are important factors to be noted when persuading staff to take up this technology and this leads to some comments that are addressed below.

Selling the System to the Customers

The current educational system allows academics to decide if they will use any technology. If technology is perceived as a threat then academics will not be inclined to take part. Academics seldom get rewarded for using technology per se. In fact, if the technology crashes and the lecture is a disaster, the teacher looks foolish.
The personal rewards one gets from teaching are seldom enhanced with technology. Academics are not in the profession for the money. Personal interaction with the students is highly valued.
Academics sometimes consider promising ways of using technology but the time spent in learning the technology followed by the time needed to create course content with the technology seems overwhelming. In order to encourage the initial outlay of time users must be assured that the system they are using will not suffer obsolescence. It is not unknown for such factors to cause resistance to change throughout an organisation. We have considered and noted the principles of change agentry in Markus and Benjamin (1996), the Cecil development team have endeavoured to provided many tools to assist the end-user in changing and continuing their mode of working within the Cecil system. Cecil has addressed this using 3 areas: Computers Supporting Learning; the future of Cecil 2000 and training. The University is also very forward thinking in its approach to training from its extensive centrally controlled training programs so that academics whose skills lie in other areas may learn to use computers and then benefit from the use of the system as a whole. Training systems and staff are now being developed in each department and faculty within the University. In doing so we have provided a facility where users may voluntarily be introduced and regularly updated with new features as they are brought on line. We understand that some users are proficient in the use of the Cecil system but regularly need to refresh their skills to aid this process we have provided a comprehensive on-line help system. Users of on-line help may also access materials from current and previous training sessions, there by allowing all users good access to help and training materials 24 hours a day.

Computers Supporting Learning

Cecil has been used at this university on a voluntary basis by academics who recognise that with a minimal investment they will get something back (http://cecil.edu/usage/).
The first step is to use Gradebook, since the University requires us to keep grades we might as well use Cecil. As gradebook provides hard copy and electronic formats that the registry require this provides a useful automated tool for the administrator.
Cecil is running on a highly reliable computer with fault tolerant systems. It is maintained and operated at the ITSS centre by a professional staff - 24 hours per day, 7 days per week.
Once their confidence is built up, academics have invested more time in creating a repository of teaching materials which can be used from year to year and accessed by themselves and their students over the Internet. These resources can be organised according to the various papers being taught.
Cecil is built on common industry software and hardware. These technologies are highly reliable and will be in place for many years to come. The software is a standard that has met the test of time. Certainly the database server has been evolving but the Cecil implementation will move with the technology and so will the course content.
Multimedia components are also an important part of the course content and we support the standards such GIF, JPEG, QuickTime, AVI, Real Audio / Video, etc.

So, to future-proof Cecil we have attempted to learn from earlier efforts to support or supplant teaching with technology. Cecil must provide value from even a minimal investment of the instructor's time. Additional services must complement or build-on the initial investments, thus compounding the benefits realised at step one.

Cecil 2000 and beyond

We believe that institutions through their academics create, organise and store knowledge and then disseminate it for effective and efficient learning. The instructional process is very personal and requires an understanding of the student, the material, and environment (cultural and otherwise).

The instructor will remain the most important component in the evolution of the curriculum. There will be national and cultural issues embedded in the curriculum that provide a value over and above that of a course offering from virtual institution on the other side of the world.

The tangible and intangible benefits of attending the University of Auckland will be measured by our capacity to translate international sources of knowledge into meaningful curricula for New Zealanders using methods that help them succeed as students and later in their professional career.

We believe that instructors can integrate knowledge bases and then provide an interpretation of these knowledge sources through a dialogue that includes self-assessment and helpful feedback can use systems like Cecil. The instructor will always be present at our institution and technology will be used by the instructor to sustain the student during periods of independent learning.

If we agree with Nielsen's vision (Nielsen 1998), then integrated media will be accessible by everyone. To a greater or lesser extent our institution and instructors will provide new views on this integrated media. The value we will bring to the learning process will be how we integrate the media into the learning strategies our students need to succeed in their career. We will need to develop in them not only the basic knowledge and skills sufficient to meet the degree requirements but also a proficiency in using our systems to sustain these skills while they are in the work force.

Conclusions

CSL is a University wide education support system. It is available to all members of staff within the University and is now seen as being a tool kit from which the academic and the student derive significant benefits. These benefits range from 24 hours 7 days a week access to grade and statistical reporting for academics and management. Whist staff are being trained and the number of courses that use the system increases yearly, the system being available University wide in 2000 the future of the uptake and use of Cecil looks bright.

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Designing an Adaptive Web-based Training System

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Abstract: In this paper, we present the design of a Web-based system for training on Internet technologies. The system will contain a variety of courses starting from introductory topics addressed to beginners and scaling up to more advanced topics. Its distinctive functionality will be its ability to tailor the presentation of the educational topics to the users' diverse needs. This will be accomplished by recording each user's learning model. Key operations of the system will be curriculum sequencing and adaptive navigation support. According to the users' knowledge state the former will adapt the educational subjects' presentation order whereas the latter will adjust the appearance of the pages' hyperlinks. Furthermore, based on the collaborative information filtering method, information regarding updated educational pages mostly interesting the users will be selectively flowed to them.

1 Introduction

World Wide Web offers the potential for revolutionary changes in education at all levels. Many have predicted that the Internet and particularly the World Wide Web will transform education since it has many capabilities for the development of interactive, media rich educational applications. The Web gives an educational system the chance to reach many real users. While the system is installed on a powerful server serviced and updated by knowledgeable personnel, thousands of users can connect to it from cheap computers. The Web is thus a highly sophisticated medium with the potential to become the necessary educational tool of the future.

Over the past years, numerous educational applications have become available on the Web. The problem, however, is that most of them are just a set of static hypertext pages. The Web though imposes certain constraints on the design of an educational system. It is vital that a Web-based educational system should encompass two features: interactivity and adaptivity. This entails from the fact that many users of diverse needs and knowledge backgrounds will gain access to the system (Stern et al., 1997; Woolf, 1992; Brusilovsky et al., 1998). Furthermore, the Web user will usually work at home alone without the assistance of a tutor. Therefore, the system should offer him/her to some degree the assistance provided to trainees in classrooms.

In this paper, we describe the design of a Web-based educational system for training on Internet technologies. The system will contain a number of courses starting from introductory concepts appropriate for beginners in Internet technologies and scaling up to concepts for more advanced users. It intends to support courses on Internet technologies offered in schools and university departments. One of its distinctive features will be its adaptivity to the users' needs. More specifically, the system will support curriculum sequencing and navigation support based on the user's learning model. Furthermore, based on the users' access patterns on the educational material, the system will cluster them and automatically inform them of any changes on their mostly visited pages. This paper is organized as follows. Section 2 presents an overview of the system. Section 3 describes key aspects of the system's functionality whereas Section 4 deals with implementation issues. Finally, Section 5 concludes.

2 System Overview

The designed Web-based educational system aims to support training on Internet technologies. It will be addressed to users of diverse needs and knowledge backgrounds. For this reason, it will contain a variety of courses starting from introductory topics and scaling up to more advanced ones. Introductory topics will be addressed to beginners in Internet technologies and will cover areas such as how various Internet tools (e.g. email client) work. Advanced topics will cover areas such as learning to program in HTML, Javascript or Java. These topics will be addressed to advanced Internet users or to users who have studied the previous topics.

The system intends to support the various courses on Internet technologies offered in schools and university departments. However, its functionality will make possible the training of users not having the assistance of a tutor. This will be based on its two distinctive features: curriculum sequencing and adaptive navigation support. Curriculum sequencing refers to the order in which the various course units are presented to the user (Stern & Woolf, 1998; Vassileva, 1995). According to what the user already knows the system will decide which course units will be presented. Adaptive navigation refers to the annotation of navigation links according to whether the user is familiar or not with the content of the corresponding pages. Furthermore, the system will provide assistance in the solving of problems.

In order to provide curriculum sequencing and adaptive navigation support, the system must have some perception of the user's knowledge, that is it must have a way of modeling the learner's knowledge state. For this purpose, the system will store the necessary information.

Furthermore, users will be informed of any changes made to the various educational pages of most interest to them (based on their accesses). In this way, instead of making users go after recently updated web pages, information is selectively flowed to them. This operation will be based on the collaborative information filtering method.

The following sections elaborate on the system's functionality.

3 System Description

3.1 User Learning Model

The learning model will record information concerning the user and regarding his knowledge state (Beck et al., 1996; Anderson, 1993). This information will be vital for the system's operation according to the user's needs. However, such data may be difficult to gather because it is not easy to represent the user's knowledge abilities. Moreover, the nature of the Web imposes certain constraints on the system's perception of the user. For the time being, it is difficult and time-consuming to record every user action.

A learning model used quite often in the past by other educational systems and which will be used in our system is the overlay model (Carr & Goldstein, 1977). In this model, the user's knowledge is considered to be a subset of the knowledge perceived by an expert in the learning field. Using this representation, the system will present the educational material to the user so that in the end his/her knowledge will match the expert's knowledge. Another way of modeling the user's knowledge is to use Bayesian networks (Martin & VanLehn, 1995; Wittig, 1999). These networks will probabilistically reason about the student's knowledge state concerning the various knowledge concepts. We do not intend to include this modeling mechanism in our system at least during its initial operating phase.

It is clear that the learning model should not contain unnecessary information so that the system will not be encumbered with useless interactions. The learning model will be based on the concepts associated with the course units (see Section 3.2). Further information modeled in the system will concern the user's acquisition and retention skills. Acquisition pertains to how fast a user learns new concepts whereas retention pertains to how well he/she remembers and recalls learned concepts. The system's response during its interaction with a user will depend on how high or low these skills are estimated to be (see Section 3.2).

Access to the system will be restricted to registered users in order to enable the recording of their knowledge state. A registered user will identify himself/herself to the system whenever logging on by giving a valid login name and password. In this way, the system will know the user's identity and will use this information to present different operations and data to him/her. An unregistered user must first submit to the system information about himself/herself (e.g. name, email address) in order to obtain an account and access to the system's functionality.

3.2 Course Design

The educational content of each course will be distributed in sections, subsections and topics. Each course unit is associated with a number of knowledge concepts. These can be either prerequisite concepts meaning that they are required to be known by the user in order to grasp the knowledge contained in the specific course unit or concepts that will be learned from the course unit. The concepts will be related to each other by describing each one's prerequisites and outcomes.

Each topic will comprise a series of educational screens. The theory contained in each topic will be presented in a variety of ways, such as interactive simulations, hypertext, appropriate images and animations. In addition, associated with the theory will be a "pool" of examples organized in groups based on the concepts they refer to. Examples will be presented to the user so that he/she grasps the theory's key points. The number of presented examples from each group will depend on the user's learning model. A user with high acquisition and retention skills will be presented a small number of examples from each group in contrast to a user with low such skills.

Based on these examples, the user will be asked to solve problems that will further enhance his/her knowledge skills. Problems will usually involve multiple choice questions in order minimize the user's effort in typing the answers and to facilitate the checking of the answers. With each problem an explanation will be stored to assist the user in case of a wrong answer. Problems will be grouped according to their similarity (based on the concepts associated with them). For each problem group, the user will have to answer correctly a specific minimum number of problems. In addition, there will be an upper limit on the allowed number of wrong answers given for problems belonging in the same group.

When a user gives a right answer to a problem, the system assumes that he/she knows the associated concept(s). Furthermore, it will infer that the user is familiar with all the prerequisite concepts as well. In this way, the learning model for the specific user will be updated.

For a specific topic, the system will present problems to the user until all concepts deriving from studying the topic are inferred to be learned. This will be based on the given answers. If too many mistakes are being made for a specific problem group, the user will be asked to revise the theory and examples for the corresponding concepts.

The given answers for each problem group will affect the system's perception of the user's acquisition and retention skills. On the one hand, a trainee giving many correct answers for each problem group will be considered to possess high acquisition and retention skills. On the other hand, if the trainee makes many mistakes within a problem group then this will affect negatively the system's induction concerning his retention and acquisition skills. In the second case, more examples from each group will be presented to the user in the next sections to help him/her acquire the corresponding knowledge.

Due to the fact that the user will probably work without the assistance of a trainer, the system should be able to help him/her in case of having difficulties in solving a problem. In that case, based on the relation between previously presented examples and the specific problem, the system will be able to present examples in order to remind the user of the previously acquired knowledge. In case the user gives a wrong answer to a problem, the system will present the correct answer and the explanation associated with the problem. These features will guarantee that the user will be able to solve the problems even without being helped from a tutor.

At the end of each section, the user will be asked to take a final test consisting of problems summarizing all the concepts learned throughout the section. The purpose of these tests will be twofold. On the one hand, they will prevent the user from forgetting concepts learned in the specific section. On the other hand, the user will be asked to solve more complex problems than the ones solved after the presentation of the section topics. These problems will combine concepts from different topics and subsections and will be organized into groups based on their similarity. For each problem, the system will store its right answer and an explanation to be given in case of a wrong answer. A final test will contain a specific number of problems from each group. Problems will be selected randomly from each group. In this way, different users will take final tests consisting of different problems.

In this case, the user will not be given any type of assistance from the system during the problem solving procedure. However, at the end of the final test and after the given answers have been checked, the system will assist the user in focusing on his/her possible mistakes. For each wrongly answered problem, the system will present the right answer and an explanation. In case the user performs very badly in a final test, the system will ask him/her to retake it. The user will be able to retake a final test on his initiative as well. Due to the random selection of problems from each group, it will be quite possible that the new test will contain different problems than the one taken before. If the user still performs badly, he/she will be asked to revise the corresponding section.

3.3 Curriculum Sequencing

Curriculum sequencing refers to the order in which the various course units are presented to the user. This will be determined by the user's knowledge state. Traditional textbooks as well as many electronic textbooks do not offer this kind of service. The author according to the needs of an average reader predefines the order of the curriculum. Such an approach, however, may not be beneficial in a hypertext environment such as the one presented to a Web user. In this case, the user can follow any hyperlink he/she desires. It is possible though, that he/she may be confused and bewildered by surfing through the educational material trying to find out what's best for him/her. Undoubtedly, this process will be time-consuming and frustrating.

Therefore, it is recommended that a Web-based educational system should offer some sort of guidance to the user by presenting the next best course units to be learned. The system will support two types of curriculum sequencing. The first type was mentioned in section 3.2 and its scope is within the context of the topic the user is currently working. It will be used in order to determine the examples and problems to be presented based on the user's previous performance (answers to problems, acquisition and retention skills). The second type of curriculum sequencing involves the selection of the most appropriate section or topic to be presented next. This selection will be made according to the concepts learned by the user. If the user has not learned yet all the outcome concepts of the current subsection (section) then the system will select the topic (subsection) with the least unknown prerequisite concepts. This goes on until the user learns the outcome concepts of all sections of the specific course.

3.4 Adaptive Navigation Support

Another feature of the system contributing in guiding the user through the educational material will be adaptive navigation support. This functionality will involve the adaptive presentation of hyperlinks to the various educational pages according to the pages' content and the user's knowledge state. According to the concepts known to the user, the state of a specific educational page can be one of the following:

(1) Ready to be visited by the user, that is all its prerequisite concepts are known.
(2) Not ready to be visited, that is some of its prerequisite concepts are unknown to the user.
(3) Already visited and its outcome concepts were learned by the user.
(4) Already visited and some of its outcome concepts were not learned by the user.

The presentation of hyperlinks to the various educational pages will reflect their state. For this purpose different link colors will be used. Furthermore, beside each link appropriate icons may be used signifying the linked page's state.

3.5 Collaborative Filtering

The system users can be classified into groups according to their interests deriving from their page accesses. Once a web page is updated with new material concerning a specific topic, the users that with certain frequency had expressed interest on it in the past are informed about the changes. Thus instead of making the users go after recently updated web pages, it is desirable to have information selectively flowed to them. This is called information filtering and is classified in two categories: cognitive filtering and collaborative filtering. Cognitive filtering chooses documents based on the characteristics of their contents, while collaborative filtering is the filtering of information based on the advice of others. In our paradigm, we address the collaborative filtering method. In our case, the users are not only informed about the recently updated web pages that they have visited quite often in the past, but also for those web pages that have been accessed with certain frequency by other users belonging in the same group of interest with the first ones. More particularly, the profile of the users' information needs is captured through their classification in groups of interest.

The classification of the users into subsets according to their page accesses will be achieved by using the spectral filtering method developed in (Bharat & Henzinger, 1998; Chakrabarti et al., 1998; Chakrabarti et al., 1999; Kleinberg, 1999). The initial motivation for the development of the method was the discovery of high-quality topical resources in hyperlinked corpora. The full power of the approach is visible when being applied on entities other than hyperlinked documents. In our paradigm, we have two kinds of entities: web pages and users accessing them. The precise notion of "access" refers to frequency of access.

In the sequel, we will outline the method of spectral filtering, as it is applied in our school environment (for more details concerning the mathematical details of the approach see (Bharat & Henzinger, 1998; Chakrabarti et al., 1998; Chakrabarti et al., 1999; Kleinberg, 1999). Let S_1 denote the set of users and S_2 denote the set of web pages corresponding to a specific section. With each ordered pair (i,j) of entities in S_1 and S_2, we associate a non-negative real-valued affinity A[i,j]. Typically, we set A[i,j] to be a well-chosen function of the accesses user i performs on page j. The A[i,j]s constitute an n x m matrix A, whose rows and columns correspond to users and web pages respectively. The entries of the matrices AA^T and A^TA can be viewed as expressing the similarity between different users and web pages respectively (where the notion of similarity is deduced from similar patterns of accesses). The matrices AA^T and A^TA are both real and symmetric and their eigenvectors have only real components. Moreover, they have the same multiset of eigenvalues. Let x_{s1}, x_{s2} be two eigenvectors of AA^T and A^TA respectively corresponding to the same eigenvalue. We can view the components of each eigenvector as assigning to each entity a position on the real line. We deem the entities with large positive values in an eigenvector to be a cluster, and the entities with large negative values to be a different cluster. Alternatively, we can examine the values in the eigenvector (in sorted increasing order). At the largest gap between successive values, we declare a partition into those entities corresponding to values above the gap, and those entities with values below. From the above discussion it follows that the eigenvectors x_{s1}, x_{s2} provides us with two pairs of interrelated clusters (c_1,c'_1), (c_2,c'_2) where c_i corresponds to a group of users with similar web-access patterns and c'_i corresponds to the web pages that interest the users in the c_i group.

Following the above partitioning process for all the non-principal eigenvectors enables us to group the users into subsets with similar preferences and to map the entities of each subset to the web pages that are of interest to them.

4 Implementation Aspects

For the development of the system, the Microsoft Internet Information Server for Windows NT will be used. The MS SQL Server will be used for implementing the databases containing the educational material and users' profiles. Active Server Pages and Perl scripts will manipulate the information stored in the databases and dynamically produce the contents of the applications presented to the users. The Macromedia Flash will be used to create many of the animations contained in the various course topics. For the implementation of the collaborative filtering service, an agent-oriented approach will be followed.

5 Conclusions

In this paper, we describe the design of a Web-based system for training on Internet technologies. The system will offer a variety of courses starting from introductory topics addressed to beginners and scaling up to more advanced topics. Its distinctive functionality will be its ability to adapt to the diverse needs of its users. This will be accomplished by recording each user's learning model, which will enable the system to tailor the presentation of the educational material according to his/her knowledge state. More specifically, key features of the system will be curriculum sequencing and adaptive navigation support. In this way, the user will receive some guidance during his/her navigation through the sections of the various courses. In addition, the user will not have to spend too much time reading and exercising with topics already known to him/her.

Furthermore, users will be informed of any changes made to the various educational pages of most interest to them (based on their accesses). In this way, instead of making users go after recently updated web pages information is selectively flowed to them. This operation will be performed according to the collaborative filtering method.

The system is intended to support the various courses on Internet technologies offered in schools and university departments. Its adaptivity, however, will enable the user to work without the assistance of a tutor. Therefore, it will be addressed to anyone interested in Internet technologies and wanting to broaden the frontiers of his knowledge. The Web's universability will enable many users to gain access to the system's operations and consequently, its functionality will be tested with numerous and diverse cases. Significant conclusions regarding the system's efficiency will thus be drawn.

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Architectural Aspects of a Web-based System for Job Ads

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Abstract: In this paper, we describe a system for job ads based on the integration of Internet and database technologies and aiming to coordinate the process of finding suitable jobs and qualified employees. Both companies and the working force in a nationwide scale can use it. Companies can post and manage ads describing the required skills whereas individuals seeking for suitable jobs can post ads describing their skills and qualifications. Numerous search facilities according to a variety of criteria and the generation of statistical graphs are offered to the system users enabling them to draw significant conclusions. The system aims to offer a connection between the various educational institutions and the job market. The paper also describes the design of an expert system intending to assist companies in choosing the appropriate employees from the system users and according to the requirements of the specific ad.

1. Introduction

There is no doubt that one of the most serious problems modern society faces is unemployment. Finding suitable jobs turns out to be a time-consuming and difficult task for the working force. Even when a person finds a job it may not be the appropriate one since it may not correspond to his/her skills. On the other hand, the companies as well very often face problems in finding the appropriate staff to assume their vacant posts.

The Web has provided a number of facilities for both companies and the working force (December & Randall, 1996; Ford & Dixon, 1996). The companies' Web sites usually contain job ads describing in detail the required skills. Furthermore, many sites include facilities for the Web users to submit information regarding their skills and qualifications. This information is then made available to companies seeking for qualified employees. Nevertheless, some problems regarding the coordination of this process do not cease to exist.

In this paper, we describe a system for job ads based on the integration of Internet and database technologies and aiming to coordinate the process of finding suitable jobs and qualified employees. The system was implemented in Greece as a result of a project. Both companies and the working force in a nationwide scale can use it. On the one hand, companies can post and manage ads describing the required skills. On the other hand, an individual seeking a job can post ads describing his/her skills and qualifications. Numerous search options according to a variety of criteria facilitate the finding of proper company ads and suitable employees. Furthermore, statistical graphs are generated based on the information contained in the ads depicting e.g. the most wanted specialties from the companies' part or the fluctuations in the individuals' specialties. In addition, links to the Web servers of the educational institutions offering the corresponding specialties are displayed to the user. The system aims to offer a connection between the various educational institutions and the job market; the users will be assisted in choosing the appropriate undergraduate and postgraduate programs that will increase their chances in finding suitable jobs.

The paper also presents the design of a decision support system intending to assist the companies in choosing the appropriate employees from the system users and according to the requirements of the specific ad. The decision support system will be an expert system based on a connectionist knowledge base.

This paper is organized as follows. Section 2 presents a functional description of the system. Section 3 presents a design of the expert system. Section 4 presents the implementation aspects as well as the user views. Finally, Section 5 concludes.

2. Functional Description

The system is addressed to two different types of users: companies seeking for eligible employees and individuals seeking for suitable jobs. Each type of user has access to different types of information and can thus make use of different system operations (Fig. 1). The system functionality is accessed through a Web browser whereas all the available information is stored in a database.

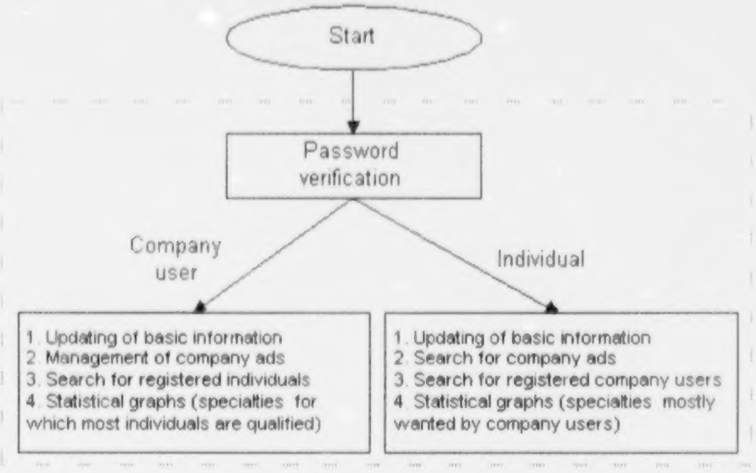
Start
Password verification
Company user
Individual
1. Updating of basic information
2. Management of company ads
3. Search for registered individuals
4. Statistical graphs (specialties for which most individuals are qualified)
1. Updating of basic information
2. Search for company ads
3. Search for registered company users
4. Statistical graphs (specialties mostly wanted by company users)

Figure 1. Operations offered to the different system users

Access to the system is restricted to registered users. A registered user must identify himself/herself to the system whenever logging on by giving a valid login name and password. In this way, the system knows the identity of the user and accordingly presents different operations and data to him/her. An unregistered user must first submit to the system basic information about himself/herself in order to obtain an account and access to the system's operations.

The primary information items stored for a specific company user are the following: name, a list of its application fields, address, telephone number, fax number, email address as well as the name of a contact person. Basic information stored for a specific individual pertains to the following items: name, address, family status, birth date, foreign languages he/she speaks, degrees (e.g. diplomas or masters) acquired from educational institutions, working experience, specialties (e.g. database developer), telephone number, email address. The level of fluency is required for each of the foreign languages the user speaks. The information items of a company ad are a subset of the ones describing an individual and correspond to the required skills and qualifications (e.g. foreign languages, university degrees, working experience, and specialties). Furthermore, the system contains data concerning the educational institutions offering the various specialties.

Special care was taken for the user interface to be functional, practical and friendly. Therefore, the user interacts through a user-friendly interface mainly consisting of forms. Most of the required form fields are drop-down lists. In this way, the insertion and searching of data becomes quick and tireless. Furthermore, the ads have a uniform view to the user, and additionally are brief and terse so that the user won't be confused by a detailed text description.

The remaining part of this section elaborates on the functionality offered to the different types of users.

2.1 Operations Offered to Company Users

The main operations offered to a company user of the system are outlined below. The user performs these operations by interacting with forms.
(i) *Updating of the company's basic information.*
(ii) *Insertion of new ads.* With this operation, a company user can insert ads asking for employees with specific skills and qualifications. The user can also insert a brief text consisting of two or three lines as a comment for the inserted ad.
(iii) *Management of existing ads.* This operation is used to manage (update or delete) existing company ads. In addition, for each ad the user can view all the registered individuals with qualifications corresponding to the ones described in the ad. These users will comprise candidates for the corresponding job.
(iv) *Search for registered individuals.* With this operation, the user can search for registered individuals according to a variety of criteria. The search is based on the values of form fields pertaining to qualifications such as specialties, working experience, etc. The user can choose if the search will be performed according to the AND or the OR function of the given values.
v) *Generation of statistical graphs.* Various statistics can be generated based on the data contained in the ads posted by the registered individuals. These statistics are in the form of bar charts and depict the specialties for which most of the registered individuals are qualified. Additionally, links to the Web servers of the educational institutions offering the corresponding specialties are displayed to the user.

2.2 Operations Offered to Individuals

The main operations offered to a registered individual are outlined below. The user performs these operations by interacting with forms.
(i) *Updating of his/her basic information.*
(ii) *Search for specific company ads.* With this operation, the user can search for existing ads according to the values of the completed form fields (e.g. required specialty, university degrees, foreign languages). The user can choose if the search will be performed according to the AND or the OR function of the given values. In addition, for each found ad the user can view information concerning the corresponding company.
(iii) *Search for registered company users.* With this operation, the user can search for registered company users according to a variety of criteria (e.g. search for companies specializing in specific fields).
iv) *Generation of statistical graphs.* Various statistics can be generated based on the data contained in the ads posted by the system's company users. These statistics are in the form of bar charts (Fig. 2) and depict the specialties mostly wanted by the companies. Additionally, links to the Web servers of the educational institutions offering the corresponding specialties are displayed to the user.

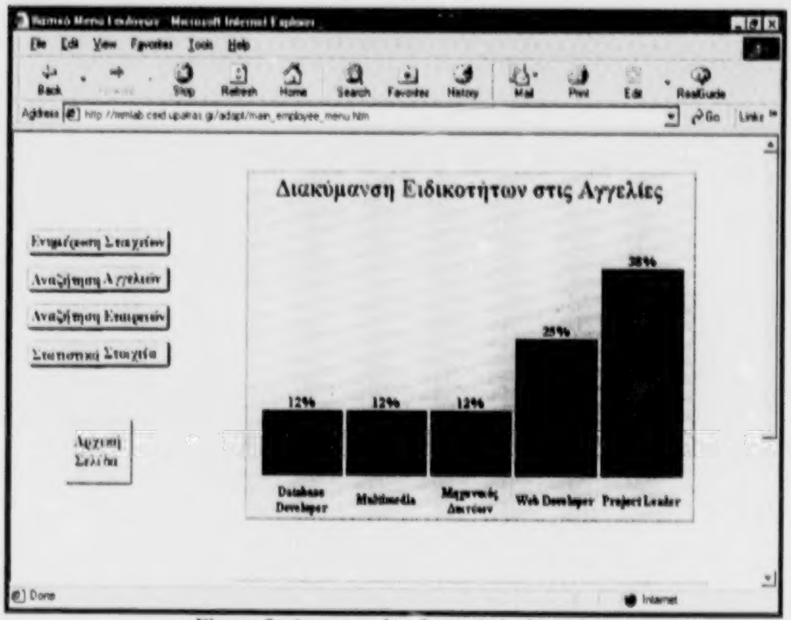
File Edit View Favorites Tools Help
Back
Forward
Stop
Refresh
Home
Search
Favorites
History
Mail
Print
Edit
RealGuide
Address
http://mmlab.ceid.upatras.gr/adapt/main_employee_menu.htm
Go
Links
Διακύμανση Ειδικοτήτων στις Αγγελίες
Ενημέρωση Στοιχείων
Αναζήτηση Αγγελιών
Αναζήτηση Εταιρειών
Στατιστικά Στοιχεία
Αρχική Σελίδα
12%
12%
12%
25%
38%
Database Developer
Multimedia
Μηχανικός Δικτύων
Web Developer
Project Leader
Done
Internet

Figure 2: An example of a statistical graph

The purpose of operation (iv) is to offer a connection between the various educational institutions and the job market. The user is informed of the educational institutions offering the most wanted specialties and therefore is assisted in choosing the appropriate undergraduate or postgraduate programs. In this way, he/she will have little difficulty in finding a proper job according to his/her qualifications. The significance of this feature is vital in the case of Greece where currently there is a loose connection between the various educational programs and what the market really wants. This fact has led to a high rate of unemployment for university degree holders.

3. The Decision Support System

A future extension of the system will include a decision support system intending to assist the companies in choosing the appropriate employees from the system users and according to the requirements of the specific ad. The system will be useful in cases where many registered individuals are found to be candidates for the specific job and will help in choosing the fittest one. The decision support system will be an expert system based on a connectionist knowledge base. The use of connectionist expert systems offers a number of advantages e.g. the ability to reach conclusions based on partially known inputs (Gallant, 1988; Gallant 1993; Ghalwash, 1998).

The construction and initialization of the connectionist knowledge base will be accomplished by inserting dependency information about the domain variables. Dependency information derives from an expert (in this case a company's employee responsible for deciding which candidate employee best corresponds to the ad's requirements) and is usually in the form of symbolic rules. These rules will formalize the expert's knowledge on the field. In this way, a network connecting the domain's concepts will be constructed. Afterwards, the network will be refined by using a neural network learning algorithm and a set of training examples (Fu & Fu, 1990). The training examples will comprise past cases of job ads, candidates for the corresponding job and the chosen person for the job.

In the sequel, we present a brief description of the expert system.

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3.1 Network Nodes

The network consists of a number of nodes representing the variables (concepts) of the domain. Each node has a number of inputs as well as a number of output connections (Fig. 3). Each input as well as each output connection is associated with a weight denoting its significance. An input can take one of the following values 1 (true), -1 (false), 0 (unknown). The output S of a node is calculated via the formulas:

$$S = f(v), \quad v = w_0 + \sum_{k=1}^{n} w_k i_k$$

where v is the node's activation value, w_0 the bias weight, i_k the value of the k-th input and f( ) the activation function shown below.

$$f(v) = \begin{cases} 1, & v > 0 \\ -1, & v < 0 \\ 0, & \text{otherwise} \end{cases}$$

Hence, the output can take one of the values, -1, 1, or 0 for false, true or unknown, respectively.

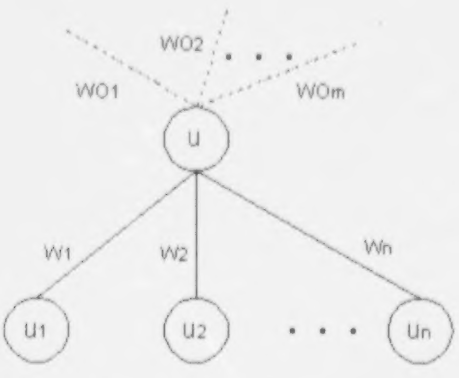

Figure 3. A network node

3.2 Basic Parts of the Expert System

The basic parts of the expert system will be the following: the knowledge base, the inference engine and the working memory (Fig. 4). The knowledge base will be produced from the initial dependency information and the training examples. The inference engine is responsible for making inferences by interacting with the working memory and the connectionist knowledge base. It will be based on the recency inference engine described in (Ghalwash, 1998). The working memory contains the values of the variables.

The system will take as input the specific ad and the candidate individuals. As a conclusion it will draw the fittest candidate for the specific job.

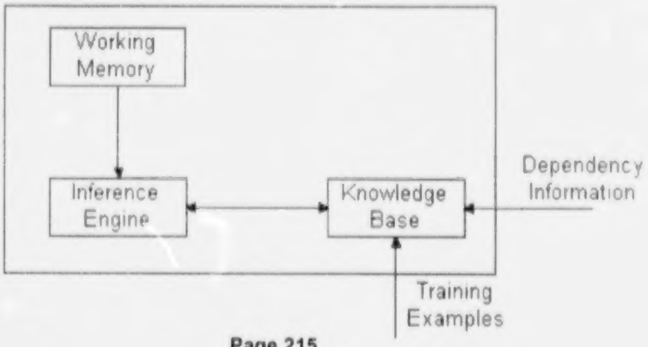

Figure 4. The expert system architecture

4. Implementation Aspects and User Views

For the development of the system the Microsoft Internet Information Server for Windows NT was used. Active Server Pages scripts were used to manipulate the information stored in the databases and to dynamically produce the contents of the Web pages presented to the users.

The user interface is unified offering different view to different users. In all views, the user identifies himself/herself to the system by giving a valid login name and password. We can distinguish three basic views as far as the users are concerned corresponding to the components of the system's user interface:

1) View of a registered individual: This view is addressed to individuals seeking an appropriate job. It offers access to all the appropriate information and operations.

2) *Company user view:* This view is addressed to the system's company users seeking for eligible employees. It offers access to all the appropriate information and operations.

3) Administrator view: In this view, the user has access to all the available information and furthermore can insert new specialties and educational institutions offering them.

5. Conclusion

In this paper, we describe a system for job ads based on the integration of Internet and database technologies and aiming to coordinate the process of finding suitable jobs and qualified employees. The system was implemented in Greece as a result of a project. Both companies and the working force in a nationwide scale can use it. On the one hand, companies can post and manage ads describing the required skills. On the other hand, a person seeking a job can post ads describing his/her skills and qualifications. Numerous search facilities according to a variety of criteria as well as the generation of statistical graphs are offered to the system's users enabling them to draw significant conclusions

The system aims to offer a connection between the various educational institutions and the job market; the users will be assisted in choosing the appropriate undergraduate and postgraduate programs that will help them in finding suitable jobs. The significance of this feature is vital in the case of Greece where currently there is a loose connection between the various educational programs and what the market really wants.

The paper also presents the design of a decision support system intending to assist the companies in choosing the appropriate employees from the system users and according to the requirements of the specific ad. The decision support system will be an expert system based on a connectionist knowledge base.

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THE PLANT INFORMATION CENTER (PIC): A WEB-BASED LEARNING CENTER FOR BOTANICAL STUDY

ABSTRACT

The Plant Information Center (PIC) is a project funded under the Institute of Museum and Library Studies that aims to provide global access to both primary and secondary botanical resources via the World Wide Web. Central to the project is the development and employment of a series of applications that facilitate resource discovery, interactive learning, and contributory opportunities within the PIC system. Initial testing of PIC will be through sixth-grade science curriculum activities involving plant identification. On a larger scale, PIC intends to promote the flow of scientific information to researchers, amateur botanists, students (elementary through higher education), and other communities interested in botanical science. This paper provides an overview of PIC, reviews the development and implementation of PIC applications, and comments on the research activities that will measure the project's overall success.

INTRODUCTION

The networked environment enables scientific and cultural resource centers to provide access to primary resources and permits students, researchers, and the general public to visit, view, and experience virtually far more than they physically could in an entire lifetime. Within the context of digital libraries, students can now take "vicarious field trips" (Marchionini & Mauer, 1995) and access "rare and unique" resources on a daily basis. This can augment and enhance the experience garnered from an actual field trip to a museum or science center. Virtual field trips can, however, be limited by the absence of contextual features. An interactive lesson plan, the ability to communicate with classmates or subject experts via electronic means, or the option to contribute new knowledge to a resource center can greatly enrich the overall learning experience.

Partnerships between resource centers and educators can enhance the traditional digital library model, and through a variety of applications provide a web-based learning center. This paper shows how one such partnership is developing applications, resources, and experience that will support a creative web-based learning environment.

WEB-BASED LEARNING CENTERS

The term digital library refers to electronic collections as well as digital resource centers with "fuller capabilities" (Borgman, 1999). Digital resource centers build on traditional library operations of collection development and reference assistance for all kinds of collections, with the goal of facilitating resource creation, enhancement, and use through interaction. Activities supported in this sophisticated digital library environment require the development of multiple applications. Within the educational arena, these developments underlie what might be more precisely defined as a web-based learning center.

Web-based learning centers include collections of digital resources that are augmented by the ability to conduct a variety of operations beyond mere search and retrieval. An example of this type of learning center is the Pennsylvania Educational Network Digital Object Repository (PEN-DOR) project (http://cumorah.sis.pitt.edu/pen_dor/start.htm). Central to PEN-DOR is a database of educational resources for both K-12 general education (e.g., math, science, history, social studies, English, and the arts) and Pennsylvania local and regional historical education. What distinguishes PEN-DOR from the more conservative view of a digital library is an interactive module and community memory reserve. PEN-DOR is supported by an application that enables teacher to build and modify existing lesson plans and share commentary on use of lesson plans via a community memory store.

The Plant Information Center (PIC) discussed in this paper is a web-based learning center that references a digital repository of botanical specimens collected for research purposes. PIC extends beyond the boundaries of a traditional library through a series of applications that support interactive learning, communication with botanical experts, and a channel for contributing resources and knowledge to PIC's information store.

THE PLANT INFORMATION CENTER (PIC)

PIC is a partnership of the North Carolina Botanical Garden, the University of North Carolina (UNC) Herbarium, the UNC School of Information and Library Science, the McDougle Middle School, and the Orange County, North Carolina, Public Library. A web-based educational initiative, PIC provides an integrated mechanism for botanical study by unifying resources and permitting access from numerous entry points. PIC includes a searchable database with digitized herbarium specimens (currently gymnosperms of the Southeast), a glossary of botanical terms, both print and electronic bibliographic resources that support botanical identification, and a list of web links to major virtual herbaria worldwide. PIC is in the process of developing an "Ask the Expert" application and an "Interactive Contributory Module" that will permit users to submit botanical resources to a community store. The contributory module will permit teachers to construct and share plant identification exercises and other lesson plans that work with PIC. An advisory group of fifteen members with expertise in the areas of science education, school media practices, botany and related sciences, database design, and digital photography have played an important role in PIC's development and continue to advise with a variety of ongoing activities.

PIC GOALS

PIC activities are supported by Institute of Museum and Library Service (IMLS), and are guided by four major goals:

- To create and test the interactive component of PIC for the general public within the context of the library environment and the public school system,
- To test the usefulness of digital images of herbarium specimens for plant identification and for inspiring the public and public school children with the aims and methods of professional botanical science,
- To demonstrate successful cooperation among the university, the public school system, and the public library in the development and implementation of a web-based learning center, and

- To develop educational experiences using virtual primary research materials from the herbarium for 6th grade students.

Project partners are working together to meet these objectives and to incorporate PIC into 6th grade curriculum activities that involve plant identification and larger questions about man's relationship to the natural world. PIC's long-term goals include making museum specimens and expert knowledge more widely available through the World Wide Web and promoting the flow of scientific information to researchers, amateur botanists, students (elementary through higher education), and other scientific communities interested in botanical science. Underlying these initiatives are a number of research goals addressing web-based educational initiatives that incorporate primary scientific source material for learning purposes. Through research and testing, the PIC team will explore image access and use, metadata issues, and electronic access to subject experts. Through publication and other communication means, the PIC team will make these research results available to the larger community that has implemented or is investigating the construction of a web-based learning center.

PIC ARCHITECTURE AND APPLICATIONS

PIC's architecture has four main components: 1.) a botanical specimen database, 2.) the Botanical Information Network (BOTNET), 3.) the "Ask the Expert" feature, and 4.) the "Interactive Contributory Module." Each one of these components represents a PIC application.

Database of Botanical Specimens

At the core of PIC is a relational database that links specimens and metadata. The database currently contains 500 images representing 50 taxa of gymnosperms (pines, spruces, firs, cedars, cypress) found in the Southeast. The database structure includes fifteen major classes that identify specimen nomenclature, link specimens to the classification authority (organization or individual), identify the specimen collection locale, document taxonomic changes in plant classification, and record digital processing information pertinent to archival images of each specimen. One central component of the database is the specimen class. This includes a number of useful attributes, such as specimen title and class; the name of the specimen collector and his/her unique identification collector number; the country, state, county, city, elevation, and other specimen collection location data; the date the specimen was collected and the condition of the specimen; and the data the specimen documentation was modified.

The database developed in Microsoft ACCESS permits a user to query using a variety of criteria, such as collector name, specimen genus, common name, locale where specimen was collected and so forth. Working with database forms, data-imputers transcribe specimen metadata from digitized copies of the original specimen labels. Data-imputers are assisted by drop down menus and the UNC Herbarium Code Book (2000). The creation of active server pages permits the database to be accessed from the World Wide Web platform. Searching activities are supported by a series of Standard Query Language (SQL) constructed queries, which can easily be enhanced, modified, or developed as needed. The ease with which 6th grade students and other general users can use the standard queries and create their own will be tested.

Botanical Information Network

A predecessor project, BOTNET (Botanical Information Network), a virtual herbarium, is ongoing and provides a major research base for PIC to draw from. Herbaria are collections of dried and pressed plant specimens that document botanical life from around the globe (Radford, 1986). The proliferation of the World Wide Web has permitted the development of virtual herbaria, although none are extensive at this point. Two leading virtual herbaria are the Harvard University's Herbaria project (http://www.herbaria.harvard.edu/5million/) and the Missouri Botanical Garden's w-3-Tropicos database (http://mobot.mobot.org/Pick/Search/pick.html). Virtual herbaria provide scientific researchers and other user communities with specimen access on a global scale. These projects are significant because they preserve collection integrity by providing access to virtual specimens, while protecting the original.

BOTNET was initially constructed with funds from the University of North Carolina's Technology Development Program. It consists of resources that botanists require to conduct plant identification activities (Murphy, 1997). BOTNET includes virtual specimens accessible via the Access database. BOTNET also includes two Hypertext Markup Language (HTML) applications; one for web accessible taxonomic schema and one for a web accessible plant glossary (e.g., Radford, et al, 1976). The BOTNET application is being enhanced via the PIC program.

Ask the Expert

The "Ask The Expert" component is a web-based application that facilitates communication between PIC users and botanical experts. A web-based form written in Perl script will permit users to submit general botanical and PIC-specific queries to an electronic bulletin board. PIC users can respond to the query through the form, and the response will also be posted on the electronic bulletin board. Botanical experts will respond to queries through a second form in a way that will ensure that authoritative answers are given to users. The expert answers will be posted to the electronic bulletin board in a different color to distinguish them from the initial query and answers coming from other PIC users. The electronic bulletin board model was selected for this feature because queries will come from PIC users working in the public library, academic or research center, or public school setting, where individuals do not necessarily have electronic mail access. If the PIC user provides an e-mail address with his/her query, the expert reply will automatically be sent to the given address as well as to the electronic bulletin board. Sharing queries and answers via this application will document PIC use and provide a community information store that will assist in the compilation of frequently asked questions (FAQ) document, which will also be incorporated into the PIC framework.

Interactive Contributory Module

The Interactive Contributory Module is designed so that PIC users can submit additional botanical resources to a community store. Resources can be in the form of atomic objects (a digitized photograph, audio clips, or textual document), a collection of objects, or a lesson plan. This module is under construction and consists of an HTML form, an Extensible Markup Language (XML) Document Type Definition (DTD) for a metadata schema, and an XML database. The HTML form permits the contributor to upload the resource with accompanying metadata. The metadata schema used in this project is based on the Dublin Core Metadata Element Set (http://purl.org/dc), an international and interdisciplinary schema designed to facilitate resource discovery of electronic resources on the World Wide Web. The metadata schema for this application differs from the Dublin Core in that it includes elements specific to the identification of botanical resources such as family, genus, and species name. Once uploaded through the HTML form, a CGI (Common Gateway Interface) script processes the metadata and the resource for inclusion in the XML structured database. The XML database is distinct from the PIC central database, because resources are not from the UNC Herbarium and because the contributors/resource creators produce the metadata rather than information science and botanical documentation experts. To insure database integrity, quality control measures will be implemented. This module will allow teachers to build lesson plans by integrating specimens from PIC's central database and resources from the XML database. The XML framework will permit experimenting with partitioning the database into separate units for atomic objects, collections of objects, lesson plans for access purposes.

PIC RESEARCH

During the last few years there has been a tremendous increase in educationally-based digital projects (e.g., the University of Michigan Digital Library project: http://www.si.umich.edu/UMDL/, Carnegie Mellon University Informedia project: http://informedia.cs.cmu.edu/ SMETE Digital Library Information Portal: http://www.smete.org). The success of these projects relies not only on the teachers and on student willingness to work with these tools, but also on efficient and effective resource access, quality metadata, and the ability to communicate with and benefit from the knowledge of human subject experts. PIC provides a prototype for investigating how to effectively develop, implement, and maintain a digital learning center that is comprised of virtual scientific specimens, textual documentation, glossaries, and an array of other resources, and that supports interactive communication and contributory activities. The

PIC team intends to evaluate the success of this project conducting research in the following three areas: 1.) image access and use, 2.) metadata effectiveness, and 3.) electronic access to subject expertise.

Image Access and Use

Most digital educational projects include image materials. Success with images depends on image upload time, the image's ability to serve as an independent resource, and the image's integration with textual or other resource types. The PIC team will investigate the relationship between image use and image download time. A botanical specimen identification study will be conducted by comparing the use of the following: 1.) textual materials found in the public library, 2.) textual materials supplemented by the PIC system, and 3.) PIC system exclusively. Research on image access and use will also examine how teachers integrate PIC images into their instructional plans.

Effective Metadata

Metadata is important to the PIC project because it facilitates resource discovery and use. Some examples of metadata for a botanical specimen are the scientific name, the geographic location where the specimen was collected, and the date the specimen was collected. Teachers, students, and other PIC users will search metadata records in PIC's central database and the XML contributory module via public interface that is similar to an online library catalog. Transaction logs will be kept in order to track metadata searching. Quantifiable research will be conducted to identify the metadata that is important for specimen access in the learning environment. This research will also help to improve the overall effectiveness of the PIC database metadata framework.

*Electronic access to subject experts.

While many digital educational projects include a communication with expert component, there is little research on the success of such features. PIC's "Ask the Expert" module will provide a data store for research in this area. Through content analyses of electronic postings and experts' responses, researchers will examine the effectiveness of this type of feature within the PIC system and raise questions about the implications of this feature for the greater digital learning environment.

CONCLUSION

PIC intends to promote the flow of scientific information to communities interested in botanical science and to provide a learning tool for students studying botanical identification. The PIC project also provides a prototype system for studying the development and employment of a series of applications that facilitate resource discovery, interactive learning, and contributory opportunities within networked environment. Through research on image access and use, metadata effectiveness, electronic access to subject experts, and the development of tools for web-based learning centers, the PIC team will contribute knowledge about the overall construction and implementation of web-based learning centers.

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Analysis of Sources of Latency in Downloading Web Pages

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Abstract: Why does it take so long to download a Web page? We analyze the download latency for pages for a variety of situations, in which Web browser and server are both within the same country as well as in different countries. Our study examines several sources of latency in accessing Web pages: DNS, TCP, the Web server itself, the network links and routers. We divide the total download time into four parts: DNS query, connection setup time, time to get the first byte of a Web page, and downloading time. In most cases, roughly half of the time is spent from the moment the browser sends the acknowledgement completing the TCP connection establishment until the first packet-containing page content arrives. The bulk of this time is the round trip delay, and only a tiny portion is delay at the server. This implies that the bottleneck in accessing pages over the Internet is due to the Internet itself, and not the server speed (as suggested by another study). The second bottleneck is the 3-way TCP connection establishment. Conclusions are drawn on how to decrease latency.

Introduction

Internet users who download a Web page from a remote machine (inside as well as outside the country) often experience poor performance. What causes poor performance? To investigate the causes, we examine the steps involved in downloading a Web page and the sources of bottleneck related to the steps. Steps involved in downloading a Web page are DNS (Domain Name Server) query, connection establishment, waiting for the first byte, and downloading the page. The sources related with the steps could be potential candidates for bottlenecks and those are DNS query, server, links, routers, and TCP. The mapping between the actions and sources is shown in (Fig. 1). We discuss each source briefly below:

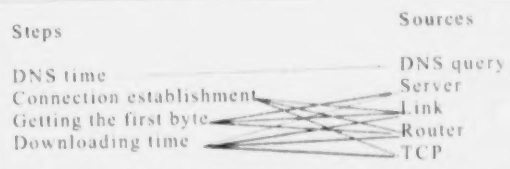

Figure 1: Mapping between Steps and Sources

The first possible source of a bottleneck is a DNS query. When a page is requested, first the hostname is resolved to an IP address by DNS and then a connection is established from the client machine to the requested host. In presence of a proxy, the page may come from the proxy. We investigate what percentage of total access time is used for DNS query. How does DNS query time vary for domestic vs. international sites?

Second, the server can be a potential source of bottleneck and can cause unexpected delay to return a Web page. The server delay is mainly due to processing the client's request. So, the server delay depends on server specification, the server load, rate of requests arriving at the server and so on.

Then, the next item to be considered as a possible source of bottleneck is link. Bottleneck due to links in an Internet route depend on the link properties. Obviously, the physical media and protocol limit the RTT (Round Trip Time) and maximum bandwidth of a link.

The fourth possible candidate is a router. If a router has insufficient buffer space or processing speed, then it will discard packets. Packet loss will ultimately lead to a high RTT. The router throughput may cause a bottleneck. An end-to-end routing behavior in the Internet is discussed in (Paxson 1996).

The fifth candidate for bottleneck is the transmission protocol (TCP) used to download a Web page. TCP's properties like three-way handshaking for connection establishment, slow-start, etc. are not suitable for HTTP. These cause problems because the median downloadable file size from the Internet is only 2K (Abdulla 1997). To overcome all the above-described problems, we have to design a new transmission protocol for HTTP. In our study, we address another problem of TCP. As a reliable protocol, TCP needs each packet to be acknowledged. TCP sets a timer after sending a packet. If the timer expires before getting the ack, TCP needs to retransmit the packet. Our concern is whether or not TCP incorrectly guesses the timeout value.

In this paper, we go through all of the above sources to identify bottlenecks and their causes.

Related Work

To address our question "why is the Web so slow?" we review different studies on the HTTP performance problem, the problem of using TCP for accessing Web pages using HTTP, Web characterization, and wide area network performance.

Several authors have investigated the performance of HTTP (see Spero 1994). We follow their steps of tracing HTTP traffic using *tcpdump*. They show that the performance problem of HTTP is due to connection establishment, slow-start, open new connection per transaction and requesting single object per connection. HTTP performance can be improved by using persistent connections, in which a single connection can access multiple files. (Touch 1996) suggest, "The persistent connection optimizations do not substantially affect Web access for the vast majority of users. Bandwidths over 200 Kbps are required to provide user-noticeable performance improvements." This conclusion is similar to the conclusion of our study. (Heidemann 1994) analyzed the performance interaction between persistent HTTP (P-HTTP) and TCP implementations and shows P-HTTP performs better than standard HTTP. But according to (Bernardo 1994), on average a user accesses just one URL at a site, which negates the benefit of using persistence.

In order to assess the quality of Internet service, an ongoing Bellcore measurement site (Huitema 1998) has drawn at top 100 URLs, and measured the delay for loading the page in four components like us. On Monday February 8 1999 (at 15.33) test, the average server delay is 3.28 sec whereas the DNS delay is 1.84 sec and connection delay is 1.15 sec. They conclude that most of the delay in downloading Web pages is due to the server, which differs from our study.

(Barford 1998), in their Wide Area Web Measurement (WAWM) project, presents performance measurements for file transfer over combinations of server load, network load, and file sizes. They measure latency and packet loss for different file sizes, under different server and network load (low/heavy). They have shown that "the main effect of server load on typical transfers is to delay the first data packet sent" and "servers under high load suffered significantly less packet loss than those under low load." According to their paper, they want to use WAWM infrastructure to address the same above question "why is the Web so slow?" in future.

Bottleneck in DNS Query or Server

In this part of our study, we measure the time taken by each step in accessing Web pages. The steps are DNS query, connection establishment, time to get the first byte, and the downloading time. **DNS Time:** The DNS component measurement is the time spent resolving the DNS name to IP address. **Connection Setup Time:** The connection setup measurement is the time required setting up a connection from a client to a Web server. **Time to Get the First Byte:** The Time to Get First Byte is the amount of time from when the client sends the request (GET command) until it sees the first byte back from the server. **Downloading Time:** This measurement starts when the first byte arrives and ends when the last byte of the file arrives to the client.

We measure the above four parts using Keynote's (Keynote 1998) tools. Keynote has 70 agents in the US and also in some foreign countries. They have tools to measure the above four time segments from the agents. We use agents: Washington DC 2, San Francisco 3, Houston 1, Paris 1, London 1 and Tokyo 1. The name signifies the geographical position of the agents. We use four categories of URLs: 100 sites prepared by (PC magazine 1998), 80 Ph.D. schools in the US, 60 URLs in Brazil, and 50 URLs in South Africa. We conduct the experiment around noon (12-2 PM EST), evening (6-8 PM EST) and night (12-2 AM EST). The daytime experiment gives us results when traffic is high inside the US and the nighttime experiment gives us results when traffic is low inside the US. We repeat it for three different days, and for each time we take three replicas for each URL. The first experiment gives us the DNS query time that is often not a local copy (Cache Miss). The second and third one normally give us the cache access time for a DNS query (Cache Hits).

Bottleneck in DNS Query

(Fig. 2) shows the four components for top 100 sites measured from Paris. It takes 0.66 sec to download a 1KB page on average, where 33% goes to DNS, 23% to connection setup, 37% to get the first byte after the connection is established, and 7% to download the file. The overall result of our experiment is DNS time 10%-25%, connection setup time 20%-30%, time to get the first byte 40%-60%, and downloading time 10%-20%. The DNS time is significant in accessing international Web sites. (Fig. 3) shows the same statistics for a replica of (Fig. 2). (Fig. 3) shows that cache hits save 90%-98% of DNS time. So, we can mirror the Name Servers, especially root and top-level domains, and distribute them based on geographic location to reduce DNS time.

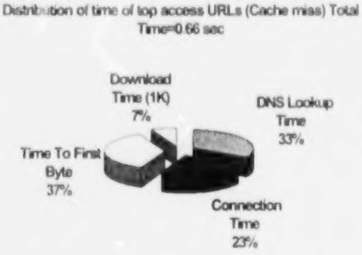

Figure 2: Four components from Paris 1 (Cache miss)

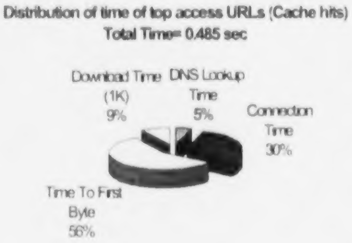

Figure 3: Four components from Paris 1 (Cache hits)

Bottleneck in Server

The most interesting fact of this experiment is that around 40%-60% of total latency is spent to get the first byte after the connection is established. A Bellcore Web page (Huitema 1998) observes a similar fraction and attributes it to server delay. According to (Barford 1998), "This delay is due to the need for the request from the client to get up to user space and then for the response to get back down to the network. This delay is very low when the server is lightly loaded." We tried to validate their hypothesis but got different results. We used the Keynote agents in Washington DC 2, Paris 1, and Tokyo 1 to access timer.cs.vt.edu (a Pentium II 300 Megahertz machine with 128 MB RAM) running Apache 1.3 on FreeBSD 2.2.7. We used file sizes of 1.58 KB, 7.6 KB, and 20.6 KB. We took several replicas and all showed that the server delay was 1-3 ms.

We imposed an artificial load to the server by using *Webjamma*, an artificial HTTP traffic generator, to send a series of URLs to timer.cs.vt.edu. We increased the number of clients such that the server can process 30 requests per sec. We also increased the CPU load as high as 100% (measured using FreeBSD *uptime* for 1 min) by running a simple floating-point calculation program in the background. But the server response time did not increase to more than 3 ms. In one case, we got a 19 ms server response time when the server was 25% loaded. We think this is an exception.

We can explain the time taken to get the first byte as a round trip time from the client to the server. The client sends an ack of the server's SYN packet and waits for the first packet. So, the client needs to wait for a whole round trip time and for the server's delay. Because the server delay is very small (1-3 ms), the round trip time dominates time to get the first byte (GFB). Most of the time, it is pretty close to the connection setup time

(CST), which is desirable. But sometimes this time goes high, which makes the overall time to get first byte high. In (Fig. 2), 19% CST is greater than GFB and 27% GFB is 50% more than the CST. The rest of the time, they are pretty close (GFB is more than CST but not more than 50% of CST). Persistent-HTTP can save the connection time for downloading a page that has more than one embedded image. In our experiment, we didn't use persistent-HTTP because we are mainly concerned about GFB not CST.

We validated the time to get the first byte as a RTT by *ping*. For this purpose, we ran *ping* while the server experiment was going on. In most of the cases, time to get the first byte is close to the average *ping* RTT and sometimes it is as high as the maximum RTT given by the *ping*.

Bottleneck in Link or Router

From previous section, we see that Web page latency is dominated by RTT. The question is what makes the RTT high? Link and router characteristics have great impact on RTT. So, let's look at the RTT analysis for links inside the US, from the US to foreign countries and vice versa. In each experimental trial, paths, from a host connected to domain vt.edu by switched 10 Mbit/sec Ethernet to the remote servers, are identified using *pathchar*. To analyze RTT inside the US, we trace path for URLs of top 80 universities and some of the URLs from top 100 sites prepared by PC magazine.

Inside US, the RTT is 20-35 ms in East Coast, 40-55ms in Central part, and 70-90ms in West Coast from Virginia Tech. We also got high RTT of 213 ms for Syracuse University and 118 ms for University of Southwestern Louisiana. Most of the RTT consumed in case of Syracuse University is inside the university. In the east part, none of the link/router dominates the overall RTT. But when the traffic goes to the West Coast, either the bottleneck is in Virginia Tech to vBNS (Very high speed Backbone Network Service) connection or in inside Sprint (backbone). So, this link or the router on this route is a possible candidate for bottleneck when traffic goes from VT to the West Coast.

An entire path, from source to destination machine, is divided into several segments (Fig. 4). Each segment may have one or more hops such as VT has 3 hops, the Overseas has one hop but Sprint has different number of hops in different experiments. Please see (Habib 1998) for details. A packet may follow different routes within each segment.

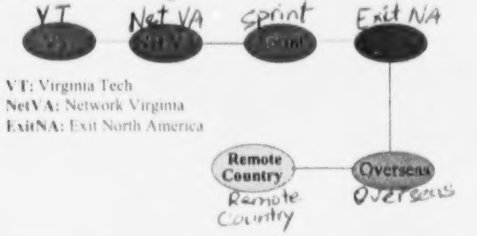

Figure 4: Segmentation of an entire path from US to International countries.

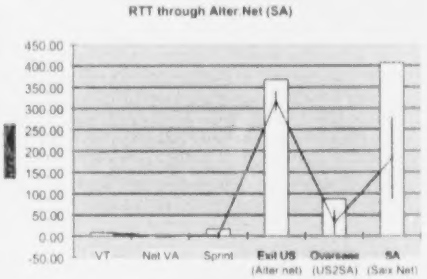

Figure 5: RTT from the US to South Africa. The red line connects all mean values. It also shows mean+stdev, mean-stdev and max(bar height)

(Fig. 5) shows the mean, maximum, with mean+stdev, and mean-stdev of RTT experienced in different segments of (Fig. 4). A very high RTT is experienced inside Canada and the US, specifically in the ExitNA segment. ExitNA segment has 40 times more RTT than VT (LAN). The standard deviation of RTT in this segment is very low, which means the segment often has this high RTT. We also observe that the Teleglobe network shows unusual behavior in the sense that it has high bandwidth, but also a high RTT. The question is why ExitNA segments exhibit a very high RTT. For this purpose, we identified the links that account for most of the high RTT. We call these as *busy links*.

There are some common properties of the busy links such that each link is inside Canada or the US and entirely in one network domain. The end routers, connect the busy link, are in very close considering physical proximity, so they are not connected by a satellite link. In most of the cases the first router of the *busy link* uses FDDI and the link is the final network link before traffic leaves the US or Canada to the overseas link. Based on the discussion above, the causes of high RTT can be hypothesized as: *A busy link router either has insufficient*

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processing capacity or insufficient outgoing link capacity. To validate our hypothesis, we measure the queuing delay throughout the path. (Tab. 1) shows the total queuing delay at routers along the paths to South Africa. Here, all US segments except the busy link are considered a single segment named "US Link."

	Min	Median	Std	Mean	Max
US Link	1.00	5.83	47.83	21.75	163.58
Busy Link	0.00	42.60	24.58	36.96	61.20
Overseas	0.00	23.80	29.88	30.54	80.00
SA	4.48	64.75	209.29	148.68	635.00

Table 1. Queuing delay (in ms) for each segment from the US to South Africa

It shows that the queuing delay for routers within the remote country is an order of magnitude higher than the rest of the path. This is explainable because the network in the remote countries has smaller bandwidth. What is more interesting is that the queuing delay at the *single router*, entrance to the busy link, is more than the *entire* queuing delay at all routers within either the US Link segment or the Overseas segment. Thus improving this single router is critical to improve the RTT.

To measure the RTT for the path from South Africa (SA) to the United States, we divide the path into three segments: inside SA, exit SA and inside the US. The bottleneck bandwidth is very low (127Kbps) in South Africa. It introduces significant amount of delay like 100ms. But the main delay is introduced by the link exiting SA, which is more than 500ms. Traffic analysis from Bangladesh to the US shows that a very high latency is imposed by satellite connection (order of 750 ms) as well as the transoceanic link (order of 150 ms). So, we can summarize the cause of high RTT for an incoming packet to the US is as follows:

- Satellite connection anywhere in the path causes high delay
- Link connecting two countries often experience high traffic and causes high RTT

From two-way traffic analysis, we see that for outgoing traffic the RTT bottleneck is in the US and just before leaving the country. Incoming traffic to the US does not subject to high latency after it's entering. So, we conclude that for an international route exit router and overseas link are strong candidate for bottleneck. This behavior also exhibits inside the US (RTT is mainly consumed in the transition link from East to West Coast).

Bottleneck in TCP

In this experiment, we investigate whether we can use TCP more efficiently or not. Our research question is how often TCP generates unnecessary retransmissions and how many of them could be saved. We conduct experiments for FTP GET, FTP PUT and HTTP GET, for four different sites (inside as well as outside the US), for 3 different file types and sizes, for 3 different times of a day, and for two different days of a week. We used *tcpdump* to trace packets. Details in (Habib 1999).

We obtained the result that unnecessary retransmission mainly happens for large file. For a large file (1.4 MB), using FTP, 50% to 60% of retransmission could be saved. For a Medium file, 490 KB, transfer with potential savings in retransmissions is 22% to 83%. Small file, 20 KB, shows almost no retransmission even in international links. An interesting result is that in LAN, TCP causes many unnecessary retransmissions. TCP performs well inside the US and causes many unnecessary retransmissions for the international countries. We summarize the results in (Tab. 2) (The worst case is the largest number for each case). From the table at most 7% of the packets are retransmitted, and no more than 3.4% of the retransmissions are unnecessary.

File (No of Packets)	VT (Retransmission)		USC (Retransmission)		South Africa (Retransmission)		Singapore (Retransmission)	
	Total	Unnecessary	Total	Unnecessary	Total	Unnecessary	Total	Unnecessary
Small (14)	0	0	0	0	7.14%	0	7.14%	0
Medium(343)	4.06%	1.45%	2.45%	0	5.52%	3.40%	2.45%	0.54%
Large (1050)	5.32%	2.28%	0.89%	0	4.19%	0.38%	2.20%	0.8%

Table 2: Worst case percentage of retransmission and unnecessary retransmission. Percentage is with respect to required packets sent.

The explanation is: transferring a large file, TCP increases the congestion window so that a large number of packets are sent back-to-back. If another sender on another TCP connection starts transmitting, it may cause losses in the first connection until that first connection reduces its congestion window. This phenomenon does not occur for the small file case, because TCP's slow start algorithm starts the congestion window at one packet, and slowly increases the size. Another reason is that TCP may incorrectly guess the timeout value for its timer due to high variance of RTT. This problem can be overcome by fine-tuning the formula $RTO = RTT + 4\ RTT_{var}$ (Jacobson 1988).

A recent article (R. Ludwig 2000) talks about *spurious timeouts*, timeouts that would not have occurred had the sender waited "long enough", problem of TCP and develops *Eifel Algorithm* to eliminate the retransmission ambiguity. This article validates our study on TCP.

Conclusion

We investigate all the possible sources of latency. Reducing DNS time will save overall downloading time. To reduce DNS time, the number of cached entries can be increased in local DNS server. We can also force to cache entries for popular servers. The next source is connection establishment time. If we use persistent-HTTP, then connection time for more than one file can be saved. High RTT causes connection time, time to get the first byte, and downloading time high. The RTT depends on Link and Router. Link bandwidth is increasing day by day. Our study shows that router is a great source of bottleneck both for inside the US and international countries. To increase the performance of router, we need more investigation. TCP can be made more robust against retransmission using technique mentioned by (R. Ludwig 2000).

Acknowledgements

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Link Proposals with Case-Based Reasoning Techniques

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Abstract: In this paper, we will discuss the problem of proposing links for hypertexts based on Case-Based Reasoning (CBR) techniques. These proposals can be used in addition to traditional textual based methods. At first, we will focus on the basic ideas of CBR. Next, its modeling for Hyperlink-Management Systems will be discussed, and finally the usefulness of CBR in the area of link proposals will be evaluated. The measuring of the quality of link proposals in terms of "recall" and "precision" has to be refined in order to describe the performance of the system adequately.

Introduction

The importance of high quality hypertexts is increasing as a result of the growth of the World Wide Web (WWW). There are several possibilities to help the user writing hypertexts of high quality. One important aspect of such online authoring tools is the support of finding appropriate links. It would be very convenient yet difficult to provide if the authoring program was able to propose hyperlinks automatically. Unfortunately, it is hardly possible to generate all the hyperlinks of an HTML-document without any human interaction.

Only the so-called *structural* or *navigational links* are easy to generate. For instance, most of the existing web tools provide means for storing files in special directories according to their departmental affiliation (Heuer et al. 1999a). Even though it is very difficult to propose meaningful links for a page on a pure textual base, this type of approach possesses several advantages. Suggestions can be made very fast and - most importantly - with a minimum of user interaction.

One the one side, there are several known possibilities for deriving link proposals on a textual (and statistical) base, but the quality of their proposal is not too persuasive (Cleary et al. 1996). One the other side, if the systems try to improve the accuracy of the proposals by applying additional semantic information, the increased quality of the suggestions must be paid by time-consuming user interaction (Hall et al. 1996).

In this paper, we will introduce a technique similar to Case-Based Reasoning (CBR) (Kolodner et al. 1995) as a possibility to fulfill the aim of providing advanced link proposals of high precision and recall. CBR can be used as a standalone method for suggesting links, but it can also be applied in conjunction with other methods to find very subtle link possibilities. Even though our main focus deals with the use of CBR on a textual analysis of documents, the same ideas can also be applied to approaches based on semantics.

After a more detailed discussion of important areas of current hyperlink research, we will present the main ideas of CBR to solve the problem of link generation. For simplicity, we will speak of "CBR" even though the presented approach is not pure Case-Based Reasoning. We will point out these differences. Our concrete implementation will then be described with special focus on inherent difficulties. Quality - mostly described in terms of "recall" and "precision" - is discussed in section 6 together with some remarks on the usefulness of these measurements and some suggestions for a refinement. Finally, we will present a conclusion and give a short outlook on future work.

Related Work

Hyperlinks in a (HTML-) text are as important as they are difficult to generate. Research on the area of hyperlinks has a long history already. Kaindl and Kramer present a good and compact summary of the main progresses made so far (Kaindl, Kramer 1999). An important step in hyperlink-proposal research can be found in a contribution of Allan. He proposes three types of links: manual, automatic and pattern-matching ones (Allan 1996). The idea there is to distinguish between links according to the difficulties to calculate or generate them automatically. In this paper, we will present a new approach to retrieve some of the "manual" links and - in addition to the classical methods (e.g. Andersen et al. 1989) - we will try to increase the amount of automatically generated hyperlinks.

The quality of link proposals is traditionally measured in terms of *precision* and *recall* (Cleary et al. 1996). In general, only time-consuming definitions of semantic structures lead to very good link proposals. The tradeoff for less user-interaction using statistical based methods for suggesting links (Gordesch et al. 1993) is mostly a reduction of the precision and the recall in the proposed results.

Cased-Based Reasoning Systems

The idea of retrieving knowledge in form of Case-Based-Reasoning systems is straightforward and not too complex (Aha 1991). The data is represented in form of cases and each case consists of a *problem* and the affiliated *solutions*. Each problem is described by attributes, which are mostly represented as linear vectors (n-vector P). Often, there are only a few possible solutions so that they can also be represented in form of a (binary) vector (m-vector S). Adequate areas for CBR concepts are diagnosis systems. The attributes of the problems are then called *symptoms* and the solution is the *diagnosis*. A good overview on that topic can be found in (Kolodner et al. 1995). Very valuable work has also been done by Richter et al. (e.g. Richter et al. 1991).

The process of retrieving knowledge based on CBR consists of two phases. In the first phase, the *learning phase*, reasonable cases are "learnt" by storing the problems together with their solutions into the case-base (figure 1).

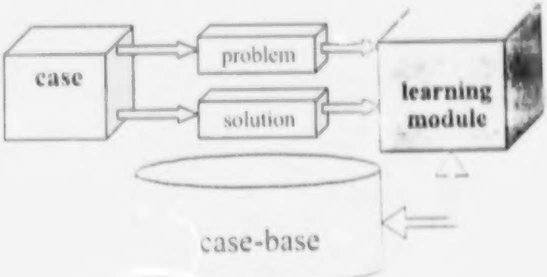

Figure 1: Learning phase of CBR-systems

Then, in the second phase, the *classifying phase*, the CBR-system is confronted with a new problem. It has to retrieve the most adequate case for the presented problem from the case-base and has to transform the according solutions for the new problem (figure 2). If possible, both phases are combined.

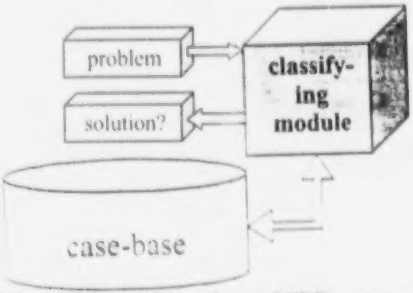

Figure 2: Classifying phase of CBR-systems

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Our idea is to model the hyperlink generation problem as a CBR-system and to use the experiences of CBR-research to retrieve high quality links as proposals for the web author. The written texts of the web authors are regarded as the problems and the hyperlinks within are the solutions. A complete hypertext can thus be viewed as a case. In the learning process, (statistical) text attributes are stored together with their attached hyperlinks into the case-base. In the classifying step, raw texts are presented to the system and the CBR process proposes hyperlinks for the text as solutions (figure 3).

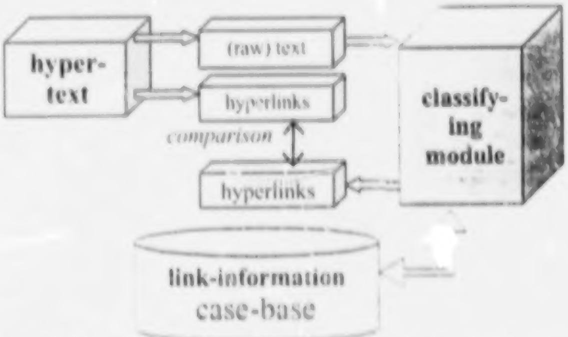

Figure 3: Learning and classifying applied to the hyperlink context

Furthermore, every new hypertext generates an additional solution – namely the link that refers to itself. Therefore, we designed the CBR-model for the hyperlink environment with an important difference to the classical approach: the cases are not stored explicitly into case-base but more implicitly without a strong relation between problem and solution. Only the importances of certain attributes for the affiliated solutions are represented in a weighted relevance matrix.

Modeling of an HLM-system Based on CBR

Our idea was the straightforward, relatively simple adaptation of the CBR-concept to the context of hyperlink management systems (HLM) and the evaluation of its potentials. CBR should only be one possibility to propose links and it must collaborate with other methods. As the environment to implement a prototype version we selected an HLM-system as presented in (Heuer et al. 1999b) where problems arising from different supported languages were also modeled.

As already mentioned in the previous section, we choose the keywords of the documents to specify the attributes of hypertexts. Other types of meta-data could also be used here (e.g. author information, creation date, expiration date) if the document was generated with an online authoring tool, e.g. *Daphne* (Heuer et al. 1999a). To find the keywords of a document, we first eliminate all "stopwords" (Chitashvili et al. 1993). All remaining words are weighted according to their position within hyper-tags (e.g. words within <h1>-tags are more important than those within <h2>-tags). At most 100 words of a text with the highest weights are treated as keywords. To investigate the attribute values of the problem vector P, the weights are proportionally transformed into the interval [0..1] (all weights are divided by the maximum value).

Implementation of the HLM-CBR

We implemented a first version of a CBR-similar algorithm to propose links on the basis of an existing HLM-system (Heuer et al. 1999b) written in Java. Here, the links are represented as objects with source document and target document as variables. Every link has its own description and refers to a default label. For simplicity, the generated link proposals supply only one (default) description.

The core of our CBR-systems consists of a relevance matrix M where the number of rows "n" and the number of columns "m" can be increased dynamically. Every entry (i,j) in M corresponds to the importance of the attribute i for the solution (link-proposal) j. Both sets, the attributes and the solutions, can take up

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additional elements any time (e.g. keywords in new HTML-texts and the hyperlinks within). The sum of all relevance values of a solution must always fulfill the following condition:

$$\forall 1 \leq j \leq m : \sum_{i=1}^{n} Mij = 1 \qquad (1)$$

The classification phase

As we have seen in the last section, a case consists of a pair of vectors, the problem P and the solution S. The aim of the classification is to find the (unknown) solutions of a presented problem P. Thus, the classification phase should supply a resulting m-vector R where the elements of R contain the probability that the according solution is applicable to P. These proposed links are presented to the user in descending order of the corresponding probability. To classify a problem P we must first "normalize" P to P^δ:

$$P^\delta = (P_i^\delta) = \begin{cases} 1 : P_i \geq \delta_i \\ 0 : P_i < \delta_i \end{cases} \qquad (2)$$

The threshold δ_i controls whether an attribute is fulfilled or not. Then P^δ simply has to be multiplied with the relevance matrix M to obtain to proposal vector R:

$$R := M \cdot P^\delta \qquad (3)$$

The learning phase

In the learning phase the relevance-indicating values of M have to be adapted so that the problem P of a presented case C=(P,S) will result in a probability vector R where all elements that correspond to a "1" in S are higher than the corresponding element of threshold δ. If necessary, both the number of rows and the number of columns in M can be increased dynamically. All new relevance values are then initialized with 1/m to fulfill condition (1). In the first version of our implementation, an element "0" in S did not lead to an adaptation of entries in M.

To be able to learn the new case C its problem P^δ has to be classified. The resulting proposal vector R is then compared to the real solution vector S of C. Four cases have to be distinguished for all elements of both vectors (table 1):

R_i	S_i	**to do**
0	0	*nothing*
0	1	*relevance adaptation*
1	0	*nothing (adaptation in next version)*
1	1	*nothing*

Table 1: Relevance adaptation

The process of learning involves a change in the relevance values of M. If a suggested probability is too low so that the corresponding link will not appear on the proposal list of the HLM-system (second case of table 1), the weight of appropriate relevance entries in M must be increased. To fulfill condition (1), the remaining weights have to be decreased by the same amount.

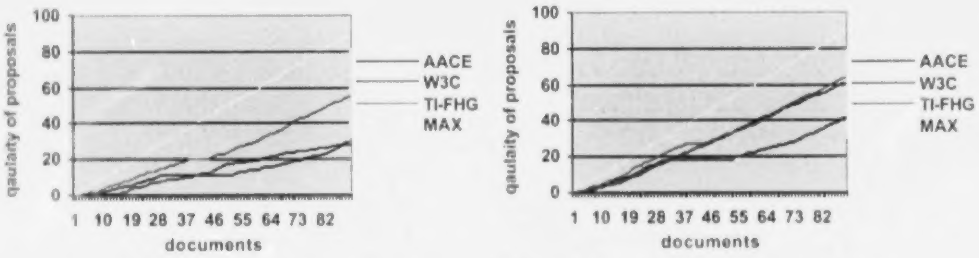
Evaluation of the Proposed Model

To evaluate the presented model on base of a large amount of data we tested the system "a posteriori" on existing web pages. We extracted the links within the HTML files, classified the raw texts using our model, and finally compared the classification results with the existing hyperlinks. Two classical terms to measure the proposal quality are *recall*, the share of appropriate proposals of all good links and *precision*, and the share of appropriate proposals of all proposals. Beside this, Cleary and Bareiss mention *ease of use* and *thoroughness* as important factors of link proposals (Cleary et al. 1996).

The system makes many proposals, arranged according to the probability of their usefulness. The user should be able to scroll in the proposal list. In terms of recall and precision this is rather problematic. What are the "appropriate" hits? A web author can, for instance, select several links from the proposal list and can create additional links herself/himself as well. It would be neither correct to count all proposals made nor to ignore the additional ones.

Due to these difficulties, we decided to split the results of our web scans into several parts. There are no unequivocal recall and precision values. Nevertheless - compared to some results so far (e.g. Cleary et al. 1996) - we think that our approach obtains a very good usefulness and implicitly a very good recall and a high precision. As an example, we show the link proposal results for the first ninety pages (beginning at the document root with a breadth-first-search-algorithm) of the *Association for the Advancement of Computing in Education* (AACE) (www.aace.org), the *World Wide Web Consortium* (W3C) (www.w3.org) and the *Institute of Telematics* (TI-FHG) (www.ti.fhg.de).

One of the most important results is shown in the following figures 4a and 4b. Here we can see the increasing sum of all probabilities in the set of proposed links that were really found in the hypertext divided by the number of those links. In figure 4a we considered all links in the scanned document and called the resulting curve the *quantified cumulating recall*, while figure 4b shows the results if we only take care of links that could be proposed, the *qualified cumulating recall*. The gradient of the curves signals the quality of the proposals. The best (maximum) line would be the diagonal. New links in a document that do not exist in the case-base can never be proposed, therefore qualified recalls are "fairer" to the CBR-system.



Figures 4a and 4b: *Quantified cumulating recall* (left) and *Qualified cumulating recall* (right)

High probability values indicate a great correlation between the proposals and the usage of these links. But a system that suggested all links in a case-based would result in even better values. It is necessary to see that mostly very accurate links are proposed ("precision"). Figure 5 presents the (growing) share of links ("hits") among all proposals exceeding the threshold, the *cumulating precision*.

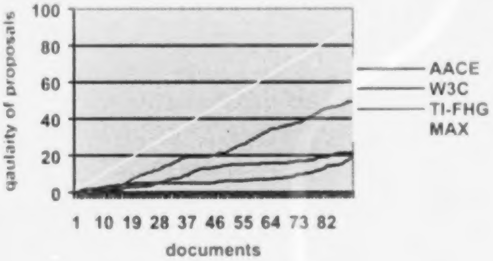


Figure 5: *Cumulating precision*

There are several other interesting relations found in our results so far. A change in the CBR threshold can lead to a very high quality proposal but also to a faster "forgetting" of former cases. If we re-classify cases that have been learnt before, the probability amount does not reach the number of real links, however. A great number of attributes (e.g. keywords) help to find very subtle proposals, but the handling of the relevance matrix becomes inconvenient. Furthermore, we also compared the highest proposal probabilities of links that were part of a hypertext to those that were not. All in all, we found a high correlation between the complexity and the length of a text and the quality of the suggested links. In some cases, a proposed link that was no part of the hypertext might have been an appropriate supplement.

Conclusion and outlook

In this paper, we described a system to propose hyperlinks for written raw texts on a statistical basis. We first discussed the underlying concept of Case-Based-Reasoning and outlined the differences to our approach. The core data structure consists of a relevance matrix that provides weighted affiliations between text attributes and possible links. The adaptation of these weights is the essential learning process that can be controlled by a threshold vector and by the mathematical distribution of the changes in relevance. To evaluate the proposed model, we refined the traditional terms of precision and recall in order to adequately measure the quality of the suggested links. We applied the system to several existing web pages "a posteriori" and found rather promising results.

In the near future, we are planning to improve the model by considering both time and document aging on the one side and user link rejection as negative information to learn on the other.

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Comparing Web Based Course Development With and Without a Learning Environment

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Abstract
Over the last five years several online courses covering different subjects have been developed and delivered in different settings at Wageningen UR. The total course content developed and delivered with a learning environment is equivalent with about 700 hours of study and the total course content developed and delivered without a learning environment is equivalent with about 400 hours of study.
The paper discusses the theoretical benefits of learning environments in general, actual experience with a specific learning environment and the reasons why it was decided not to develop every course in a learning environment. Furthermore the paper describes and evaluates the current development approach which is based on a set of tools for web site management and tools for authoring of content.

1. Introduction

Over the last five years several online courses covering subjects in computer science, construction, geophysics, geographical information systems, recombinant DNA technology, food process engineering and food fermentation have been developed and delivered in very different settings at Wageningen UR. For some of the courses a web based learning environment has been used, for other courses a web site management system complemented with a set of techniques and tools has been chosen. The total course content developed and delivered with a learning environment is equivalent with about 700 hours of study and the total course content developed and delivered without a learning environment is equivalent with about 400 hours of study by the average student.
This paper describes the main functions of learning environments and discusses the theoretical benefits of using such a learning environment. Next the paper describes an in house developed learning environment based on MS SQL Server and Cold Fusion and the experience with this specific learning environment so far.

Based partially on this experience in web based course development about two years ago two more projects were formulated to develop and produce web based courses in food and biotechnology and geographical information systems. First the objectives of these projects will be described as well as the intended scenario followed by an explanation of the reasons to make a transition to a rather different scenario without a learning environment.

The paper describes and evaluates this second scenario based on the use of MS Frontpage 2000 and a complementary set of tools and techniques such as Java script, ASP, JOUST and several other tools.

Learning environments.

Over the last few years many learning environments became available such as Lotus Learning Space, Pathware, Librarian, Ingenium, OLA , NGL, Blackboard, Gentle, webCT, Referentia Learning Systems Mercator, Swift, Vcampus to mention only a few. A good overview of relevant functional requirements can be found in (WSU 2000).

A look at the functional specifications of commercially offered learning environments shows much convergence: at a high level most of the designers agree on the following functional specifications:

- User management and authorization, users having roles such as: the role of student, instructor, author, examiner, reviewer, and etceteras.
- Management of reusable content
- Course and curriculum configuration (ideally including dynamical configuration)
- Enabling computer supported collaborative learning and communication between users
- Tracking and tracing and adjusting (manually or automatically) of user profiles and authorization

This set of main functions implies that each user is offered an environment in which (s)he can optimally perform his/her own role. Every group of users will have their own set of sub functions. For instance students and authors will have search, navigation and orientation functionality. Authors will have meta data entry and structural hyperlink management functions. Administrators will have user and group management functions.

Supporting the creation of digital learning material is generally not considered a function of a learning environment but a function of an authoring tool. Ideally lecturers create reusable content objects (RCO's), store these reusable content objects in learning environments and use the learning environment to create learning routes for students where these reusable content objects are stepping stones along the route. An RCO can be any object, ranging from static text, picture, animation, sound and video to interactive text , simulation and animation.

The paradigm which is implicit in the main functions that are supported by commercially available learning environments, does not include support for instructional design. A learning environment supports many different instructional models i.e. enables course developers to provide students with different scenarios with learning activities.

Developing and delivering courses in computer science and related subjects.

In 1995 a start was made with the development of low budget online courses in computer science. The main objectives where to make computer science education more attractive to the students and to reduce the workload for the instructors in the computer lab.

Traditional computer science courses consisted of a series of lectures separate computer lab sessions. Students making assignments in the computer lab are confronted with an incredible amount of detail. This results in students getting stuck already during an initial stage of the assignment. To resolve this problem the necessary details were told to the students in advance during the lecture and a high staff/student ratio was maintained for computer lab sessions.

The solution was to present all the necessary detailed knowledge in 5 minute audio visual movies (Lotus Screencam ® or Hypercam ®) and to offer those movies "at the right moment".
For students this meant: no boring lectures with a plethora of details and during the computer lab session no waiting for the instructor to come along to relieve one from a stuck state.
Students view a short presentation (5 minutes), work on an assignment (45 minutes) and view - if necessary - movies with hints or answers.

The ARCS model (Keller 1987) was chosen as the main guideline in instructional design. The ARCS model is used as follows: every movie and every triplet was created and placed in an order with the ARCS model in mind. The author would answer for each movie and each triplet the questions: will this movie in this stage of the course really catch the Attention of the student, be perceived as Relevant by the student, support the Confidence of the student, and generate Satisfaction.

Initially an extension to the MS Windows Help system was made in order to manage and deliver the movies. To allow easier management of the ever growing content a web based application built with MS SQL Server and Cold Fusion was designed and implemented.

Because the ARCS model was so easy to apply and helpful in designing motivating course material it was decided to baptize the web based application the "Keller system". This does not mean in any way that the Keller system itself forces the author to use the ARCS model.

The Keller system should be used as follows. A course is delivered once a year in the computer lab. During these sessions it usually turns out that certain RCO's are misleading or confusing or should be offered in a different order. This leads to immediate improvements in the course.
Apart from these supervised computer lab sessions students can start the course any time and any place and take an exam also at their own convenience. They can communicate with the lecturer by phone, e-mail or chat or knock on his/her door. Students are encouraged but not obliged to work in small groups.
Today several hundreds of students in three departments have followed courses in the Keller system. Most students are positive about the courses they have attended. Students like the type of assignments, the fact that initially they don't have to read much and the fact that they can do the courses outside scheduled time slots.
Smart students are generally less satisfied with movies: they feel that watching movies slows them down because they cannot scan a movie as quickly as they can scan a written text for just that one thing they need.
Lecturers and instructors working with the Keller system are satisfied the underlying philosophy and feel that their efforts are in balance with the results.
The fact that the Keller system uses http to deliver course material, netbios file sharing to upload course material by lecturers and Banyan Vines to upload students' homework requires maintenance of three sets of user accounts. The Banyan Vines dependency, requiring a network account, limits the group of students that can attend the online courses resulting in frequent requests for a course CD ROM. This is an important detail because several commercially available learning environments essentially know this same problem although it is often difficult to detect this in their functional specifications.

Developing and delivering courses in Food and Biotechnology

Main objectives

Food and Biotechnology as well as Geographical Information Systems are, much more than computer science, core competence areas of Wageningen UR. In particular the Educational Institute of Technology and Nutrition (EITN), which is the school responsible for education in Food and Biotechnology has made its objectives very explicit.
The reasons for the EITN to invest in development of web based course material are based on the strong belief that - for a modern university - it is important to be present and visible on the internet, not only as a research institution but also as an educational institution providing high quality education in those areas which form the core competence of research this specific university.

The EITN regards web technology as the enabling technology to realize the benefits of economics of scale in higher education. By experience it is well accepted that the overall quality of lecture notes written for only a limited cohort of students cannot compete with a good textbook (Stryer 1995, Alberts 1995) intended for a large audience. The reason is that it seldom makes sense to invest heavily in course material intended for a very small audience. This argument is just as valid for digital course material as it is for textbooks. The current internet developments will enable universities to reach a larger audience and thus to raise the quality of course materials. Furthermore the EITN promotes life long learning in an international community. Thus the main objectives are: to develop high quality digital course material, to enlarge the audience, to offer a wide range of students in different settings different learning scenario's and to improve the web presence and visibility of the university.

Intended development Scenario

When the development of web based courses in food- and biotechnology and geographical information systems was started, the following development scenario was planned:

- Define learning activities
- Select a commercially available learning environment
- Define a course material development methodology
- Define together with authors a subproject for each subject
- Give authors a course in web based course development
- Give authors sufficiently didactical and technical support
- Start developing

This scenario is somewhat inspired by the traditional textbook publishers approach and also by what has been called the learning environment paradigm. It is clearly a scenario intended to create synergy between the several subprojects for instance by using one technological basis for all subprojects.

Later sections explain the reasons why this scenario was gradually replaced by a rather different scenario.

Different Learning activities lead to composite RCO's.

Typical learning activities in computer science, systems modeling, agricultural engineering etc. were 45 minute assignments for a computer program, (testing) a mathematical model, do some calculations etc. The Food and Biotechnology project and the Geographical Information Systems project however required learning activities which were quite different because of the course content and learning goals.

Two students were asked to scan the web for course material in food and biotechnology and to compose a top ten of course materials they liked from their own viewpoint. From their results it was concluded that for subjects in food and biotechnology typical learning activities should often be more related to real life situations. Most of the courses are now case based, wherein the student is placed in a role of junior consultant or lab supervisor. The student, for example, has to provide advice on optimizing a production plant or to diagnose errors in an experimental set up.

This type of learning activities introduces the problem of composite RCO's. A composite RCO is an RCO which it self consists of a structure of linked RCO's. The didactical approach based on cases needs composite RCO's that use their own navigation based on user interaction. Because of the interaction this navigation is hard to implement within a learning environment. An extreme case is the situation where one has only a few RCO's in a learning environment that have their own navigational structure. Clearly this would undermine the reasons to use a learning environment at all. In fact this occurs already in the process-engineering site.

Selecting a learning environment.

The experience with the Keller system had supported the belief in the benefits of a learning environment and also provided a good idea of the desired functional specifications. It was soon clear that several learning environments had more potential than the in-house developed Keller system. A committee was formed to select a standard learning environment. However during the short selection process some learning environments where retracted from the market, some environments were integrated with others and several new candidates appeared. The turbulence in the market was one of the most important reasons to postpone the definitive choice for a learning environment.

The general opinion still was that the benefits of a learning environment will eventually outweigh the limitations of a learning environment. But two things were cause for concern: firstly not one vendor of a learning environment could give a pointer to course material which appealed to the students, and secondly not one of the examples that did appeal to the students was build with a learning environment.

Yet another reason to postpone the final choice was the overlap in functionality between a learning environment on the one hand and functionality which was being realized in a digital library project within the university (including the digital learning material) and a new student administration project.

Finally in practice the most important factor in many decisions during initial development of online courses is the satisfaction that authors derive from their development efforts and the expectation that faculty members have from future benefits. One of the problems is that the benefits of a learning environment only become visible when a certain critical mass has been attained. It was foreseen that working with a learning environment initially might involve too many tedious tasks and that faculty members might drop out.

Current Approach

In the meantime course material in food and biotechnology and geographic information systems was under development. This course material is developed using Front page 2000 and JOUST for navigation and server and client side Java script and Java for interaction.

At the time of writing only about 20 to 30 students have provided feedback on the course material. This feedback is very favorable on the didactical approach but very critical on many practical details.

The development approach is very much an evolutionary approach inspired by ideas like rapid application development or DSDM (Stapleton 1997) in information systems development.

Sometimes lecturers come up with ideas for certain functionality and the technical support team implements this functionality. Some lecturers try to implement ideas for functionality in a prototype themselves in order "to be able to go on" and in order to be able to clarify their request to the technical support team. Some authors just "throw their ideas and content over the wall" and let the support team do most of the non content related work. In this teamwork with the faculty members the technical support team acts as a powerfull "bottom up" stimulator for faculty members to invest their valuable time in development of digital course material. (cf. Collis & Wende 1999 section 4.4.2)

Lecturers use a Frontpage web as learning environment and at the same time use Frontpage as an authoring tool for some of their RCO's in particular. Creating navigational structures at learning environment level requires the same skills as creating navigational structures at the RCO level.

Because Frontpage is also elsewhere in use for normal website management there is a certain critical mass of Frontpage users. The current set of tools gives more room for experimenting than working with a learning environment.

Still working with Frontpage instead of a learning environment is regarded as a temporary solution because there are some disadvantages as well. First of all the borderline between RCO and learning environment has become quite fuzzy. This will create some problems when the transition to a learning environment comes later on. Secondly a package like Frontpage invites faculty members to dive into technological details and time invested in technology is time lost for didactical creativity. Furthermore Frontpage does not keep faculty members on one common track like a learning environment would do. On the one hand Frontpage gives more freedom than a learning environment on the other hand more advanced users switch to more flexible tools and

the support team feels inhibited by the inflexibility of Frontpage when implementing the "throw their ideas and content over the wall" concept. Supporting authors who work with Frontpage and extending its functionality also incurs certain costs. Finally the functionality of the current Frontpage based web including home built extensions is still much less than the functionality of a learning environment.
To summarize: working with Frontpage provides more flexibility than working with a learning environment but at certain costs and these costs are expected to increase rapidly with increasing volume of course content.

Conclusions

Experience with development of digital course material along two different scenario's has been described. Based on this experience the ideal setting for development of online course materials is defined as follows:

- The university supports one learning environment for every learning scenario and every lecturer
- Lecturers create modular digital learning materials (reusable content objects) with authoring tools of their choice.
- Lecturers do not invest their valuable time in matters of layout, HTML, XML, Javascript etceteras. Lecturers are supported by a small support team to that end.

This setting is not fundamentally different from the production setting that a publisher provides for textbooks.

Choosing a standard learning environment is partly a matter of careful timing. The choice for a standard learning environment was postponed for the following reasons:

1. The market for learning environments is currently too turbulent: environments are being integrated into other environments and environments are retracted from the market. The risk that a freshly chosen standard will soon end to exist is too large.
2. Within the university administration new systems for student administration are being developed, and within the university library new ideas for management of digital learning material are coming up. Having three systems with considerable overlap in functionality is at least sub optimal.
3. Composite RCO's are difficult to deal with in the currently available learning environments.
4. Learning to work with a learning environment requires usually considerable efforts from lecturers, while the benefits will only become visible much later.
5. Until now none of the vendors of a learning environment has been able to demonstrate a convincing lighthouse application that can function as a paradigm example for courses to be offered with this learning environment.

The current approach of developing digital learning material with MS Frontpage 2000 and extending the functionality when necessary is felt to be satisfactory. The advantage of the current approach is that it is very flexible in particular with respect to composite RCO's. The disadvantage of this flexibility is the costs for development and maintenance it incurs.

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Signed Preservation Of Online References

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Abstract: Since online-available documents are more and more outclassing paper based documents, the use of online references is constantly growing. Online references suffer strongly from their often only temporarily character. With the slightest modification - not to mention a complete removal of its online references - the scientific value of the referencing document would decline. Therefore, mechanisms are needed that strive to preserve the value of the documents in digital libraries. In this paper, we will discuss the concept and prototype implementation of a service that can help to minimize this problem. The service produces files which contain signed data referring to the online documents. These files will be used as fall back online references. Offering this data-file analogously to the link that points to the original online reference gives every user the opportunity to recover the respective online document even if the original reference was modified or is not available anymore.

1. Introduction

Anyone is familiar with the serious problems that arise from the use of online documents in scientific work. The trouble with online references is their more or less dynamic character. An online document can get modified over time, can be moved to a different location or can even be removed all together. In either case, the reference pointing to that document becomes, in most cases, worthless. Although this problem is not restricted to the scientific field, it becomes very obvious here. The value of scientific work depends to a vital degree on its references. Only if a comprehensive summary of related work is given, can the author's intention be understood and the value of the work be determined. Furthermore, references help to prevent detailed descriptions of features that have already been discussed somewhere else extensively. The problem described here is recently becoming more urgent since online references become more and more common these days and outbalance paper based references.

In this paper, we will focus on these problems and will offer a quite simple but powerful solution. We will develop a concept and describe a prototype that can be used to evaluate the concept.

2. Concept

In order to solve the missing online reference problem, we tried to find a simple mechanism that can be used commonly. Of course the additional effort for the author of a online document should be minimal. Only simplicity and rapidness of the procedure will result in a broad application on the World Wide Web.

The concept that we developed in order to provide reliable references in online documents is based on a gateway service, that provides after any data transfer it handled a digitally signed [1] log of that transfer. With the signed data transfer log (SDTL) the user is afterwards able to prove the data transfer he did. If he offers those files to any other users, they can in hindsight reconstruct the data transfer. Since the log contains a signature, the correctness of the log can be verified at any time.

A special scenario, where this mechanism can be applied is of course the authoring of online documents. So if an author wants to use a online reference for his online document he only has to use a commonly trusted gateway offering that service. Transferring the content of the online reference via the gateway gives him afterwards a SDTL. This SDTL will contain the request, the reply and the document itself as well as the signature.

Analogous to images linked in his/her online document the author now can provide the SDTL along with his document. Any link to an external online reference should then be followed by a link to the local available SDTL of that reference. Now if the external online reference is later removed or modified for any reason, readers of the online document are still able to get the original content of the reference in form of the SDTL in a reliable way. It takes little effort for them to validate the SDTL. If the owner of the certificate given in the SDTL is trust worthy they can now believe in the "copy" of the online referenced document.

2.1 SDTL-Conglomeration

The concept of the SDTL does not determine, how many "documents" with their corresponding transfer logs can be included in one single file. Of course it is possible to put into one single SDTL all components, e.g. images, that belong to the referenced document. Then a document with all its components would be packed together.

The next step is based of the thought, that the document D one wants to reference itself already references online documents X,Y and Z. Guessed the concept of the SDTLs finds broad use, the author of D would also provide along with D SDTLs for X,Y and Z. Now a packaged SDTL of D would also include the SDTLs of X,Y and Z.

Such an assumption implies several impacts. We would like to mention two of them. At first the SDTL's size could grow into bulky regions. At second the higher the depth of the reference chain becomes, the more the probability of duplicate entries rises.

Solutions for SDTL conglomerations can be found either on sensible policies that constitute a sensible depth of SDTL chains or in the concept of commonly accessible persistent services that is described in the employment section of this paper.

2.2 Public Key Infrastructure

Although not directly claimed, only a working PKI [2, 3] can provide the basis for the broadly introduction of SDTLs. The critical point, where a PKI is required is the verification of the Certificate of the trusted third party that runs the gateway. Furthermore a validation service [4] is needed. In both cases there are detours possible, but the elegance of a PKI based solution is not reached.

3. Prototype Implementation

In order to test the concept we implemented a prototype gateway program that offers the service described above. The gateway program is a multi-threaded server implemented in Java [5]. On the one hand Java was chosen, because of its platform independence. Coded in Java the program can be executed on most of the available platforms. On the other hand Java provides a powerful security api [6] along with several tools [7] handling security relevant tasks.

Any client that wants to use the service must change the preferences and configure the browser to use the gateway as a proxy. Therefore the gateway program listens on a given port for HTTP-requests [8] from clients. Those requests are forwarded to the destination web-servers. The corresponding replies of the servers are transferred back to the clients. Each combination of request and the respective reply, building a request-reply-pair, is logged by the program.

Of course the program has to distinguish between requests that came from different clients. Therefore an identification of the clients is required. The prototype identifies at the moment each client by its ip-address. This mechanism of course only works, if not several clients share the same ip-address. Further improvements may result in a more sophisticated version of our prototype where implementations could for example provide a dedicated port for each client after registration for the service.

After a browsing session, e.g. consisting of the download of a document with the appropriate images, the client connects directly to the gateway. Since the gateway itself is addressed in this request, it will be handled in a different way. The server looks in its logs, temporarily stored in memory or in future implementations in a database, for all requests that came from that certain ip-address. It transfers to the client a list with all those requests from the last session. Since no registration was made, the session itself is no real session. At the moment requests of a convenient time period of some minutes are stored in the memory. The list displayed to the client in a HTML-page contains for each request a link that triggers the creation and delivery of a SDTL. Creation of a SDTL means that the request and the reply are signed and stored in a file that is then downloaded by the client. After the download of a SDTL the user can provide it himself along with his/her online document that references the online version of the document contained in the SDTL. Although the prototype does not support that feature, it is planned to offer some kind of bundling of requests in a SDTL. Bundling in this case means, that if a online document consists of several parts, e.g. HTML-page plus some images, those requests all will be packed in a single SDTL. Then anybody that has access to the bundled SDTL is able to reconstruct the whole document in focus.

Of course the SDTL-files that can be downloaded from the gateway have a certain format. For the ease of implementation we choose the Jar-file format [9] as appropriate to be used in a prototype. The format offers two features. At first the Jar files are compressed, which is no problem, since the Jar format is based on the zip-format [10]. This is quite important, since it minimizes the place required to store the data. Furthermore it fastens the transfer of SDTLs through the network. At second Jar files were designed to encapsulate data and signatures in a single file. This offers two further advantages. At first there is no new specification to be developed that determines how any signature is to be stored in the file. At second there are tools [11] broadly available that allow the validation of the Jar file. This is very important insofar that in principle everybody has the ability to verify a SDTL.

Our prototype gateway creates the SDTLs in the following manner. It creates a jar file that contains originally five files. One file for the request header, one file for the request data, one file for the reply header, one file that is the requested document itself and finally the manifest [12]. Where the manifest is a kind of directory listing of the Jar file's content. After the creation of that Jar file the gateway uses its private key to sign the archive. The signing action results in two more files that are stored in the Jar file. Those files are the signature file [12] and the signature block [12].

As mentioned above in principle validation of the SDTL is possible for anybody, since the accordant software is distributed in a bundle with the JDK freely by SUN. The verification of the signed Jar file can be done with the jarsigner tool [11]. This is a command line based tool and therefore not as easy to handle as a Graphical User Interface (GUI) based tool. Nevertheless one can with a simple command find out, if the signatures are correct.

The validation process consists of two task. The first task is the import of the certificate of the party that did the signing. This certificate has to be accepted as trusted by the user. In the terms of Java this means the user has to import the certificate with the keytool [13] into his/her keystore [13]. The second task is the actual verification of the signatures contained in the Jar file. For each stored file the jarsigner verifies the signature and finally makes a statement that tells if the complete Jar file was successfully verified. In short the user has to check the correctness of the certificate and the correctness of the signatures of the Jar file to be able to trust in the SDTL.

Although the prototype uses the Jar file format as an concrete implementation of a SDTL there is no reason, why not other formats can be developed and employed. Possible candidates could be derived from the XML-Signatur initiative [14] or the Signed Document Markup Language [14]. Depending on the requirements other information can be added to SDTLs, probably signatures given by the document authors themselves.

4. Employment Scenarios

At the moment we have two different employment scenarios in the field of digital libraries and therefore the provision of online documents on our mind. Both scenarios have in common, that the worth of a online document is preserved by the provision of reliable, persistent copies of the online references used in that document. The scenarios differ with regard to the storage location of the SDTLs. On the one hand one can imagine a solution where the author of a online document stores the required SDTLs himself. He/she places the SDTLs of all online references used in his/her document like images somewhere in the document-root near the document. This enables anybody the has access to the document to download the required references in the form of the SDTLs as well.

On the other hand it seems feasible to provide a commonly available persistence service for SDTLs. This service could provide commonly SDTLs with a unique URI for each SDTL. In that case the SDTL is still generated as described above. Instead of a download by the client, a form could be presented that offers the user a 'contract'. In this 'contract' the service provider could commit itself to keep the newly generated SDTL at a given URI online available for a certain time. This time is equivalent to a guarantied lifetime of the reference. Therefore a expiration date for the online reference is given. About an extension of the period could be negotiated at any time.

For each SDTL at the persistence service a unique URI must be assigned. Any author referencing a online document could then provide along with the actual URI of the online available reference a corresponding link to the URI of the SDTL that is located at the persistence service of the service provider.

Both services, the signing gateway as well as the persistence service, would increase the value of any digital library. Therefore the parties offering the digital libraries could probably have great interest in the provision of those services them selves.

5. Usability

The concept that we suggest in this work is quite easy to handle from both sides, the service providers as well as the users. Most important is the fact, that there are no modification at existing systems required. Authors of online documents have only to download the online available documents that they want to reference via the gateway service described in this paper. This enables them to request a SDTL that can be employed to prove the data transfer as well as the content of the downloaded documents. Online references in any newly created document are not eliminated, there is only an endorsement, the SDTL. Problems with a missing or modified online reference can be solved by the employment of the SDTL. This file allows a simple reconstruction of the original document. Furthermore its authenticity is guarantied by the hopefully commonly trusted party that generated the SDTL.

Supposed that there will be tools developed for management of SDTLs the concept will not result in any higher additional effort than the effort required to manage a reference database with bibliographic content. In fact the SDTLs can increase the value of such a reference database dramatically. Next to the bibliographic information and the URI of a reference there is also the document available. But not only available, its content is provable for others. Therefore the references stored in this way are even more valuable.

While any private use of the SDTL will not cause any problems, a publication of the concerned documents must take the question of the original author's copyright into account. Probably consensual agreements with the referenced authors provide a suitable solution for this problem.

6. Related Work

In this section, a short overview about similar concepts will be given. On the one hand, one can concentrate on systems that try to preserve links [16,17,18]. Their problem arises from the modifications that have to be implemented in the server software as well as in the used data transfer protocols. Furthermore, they cannot solve the problem that will occur when a linked document is not available online anymore.

On the other hand, we have to mention electronic notaries [19] in line with time stamping services [20]. The service we describe in this paper which is to be used in the field of digital libraries is a combination of an electronic notary and a time stamping service. In spite of the employment of separate services, we propose a single, integrated service. Furthermore, with the inclusion of the protocol header information into the signed log-file, additional value will be given. Its importance becomes obvious in cases like content negotiation [21] between the browser software and the web-server.

The most crucial feature distinguishing our concept from, for example, bi-directional links, is that no additional work for the author of any referenced document is implied. The concept does not require that any author digitally signs his or her document or maintains it in any other way. It is only the person wanting to preserve an online document - the document being a valuable online reference for him or her - that will have some additional costs. This person has to employ the signing gateway service and has to provide for the provision of the SDTL.

7. Outlook

As mentioned in several sections of this paper, at this stage, our work is still a combination of a concept and a prototype implementation. On the one hand, the prototype helps to evaluate the concept. On the other hand, it will probably result in - hopefully minor - changes of the concept that will encourage its broad application.

Of course, the usability of the concept requires a working PKI. In combination with GUI based tools that handle the management of the SDTLs, the employment of the concept seems possible.

Thus, there is a need for the conception and prototype implementation of a client which offers a slight automation of the SDTL management. Several features are planned for such a client program. In addition to the request of SDTL conglomerations, there should be features that allow simple validation of SDTLs. After the download of a SDTL, the client tool should provide fast and easy access to the included documents as well as the transfer information.

All in all, the SDTL management client can be implemented as a kind of personal reference database that can be enhanced with corresponding bibliographic information. Given the fact that a SDTL also contains the document in question itself, one could speak of a personal digital library. Since the content can be proved with the help of the trusted third party that signed the data transfer, the evolving local library is gaining value.

As described in the prototype section, further development of the actual gateway program will focus on the generation of dedicated sessions. The combination of session-information and the intelligent arrangement of all requests related to a certain online document will increase the usability of the service.

8. Conclusion

Anybody working a lot with online references is familiar with the advantages that are connected to their use. Nevertheless, documents that depend on a high number of online references tend to become worthless within, sometimes, the shortest time. Reasons for this fact are modification, movement or removal of the referenced online documents. Mechanism that try to preserve the links to the original documents are very difficult to create. Furthermore they depend on certain techniques on the server side. The catchword for this is bi-directional links.

In this paper we report a concept and a prototype that is especially interesting in the field of digital libraries. Our concept has the great advantage that no modifications of any web-server are required. Furthermore, the authors of any online resource do not have to modify their documents, by giving, for example, additional provision of digital signatures.

The gateway concept guarantees that the service is available for anybody who trusts in the party that is offering the service. The use of the service is quite easy and the prototype's data-transfer log format (Jar) already offers a practicable solution.

The service we suggest here does not help to fix the broken link problem itself. What it does is to offer the possibility of reading the content of a refereniced document no matter if the original document was modified or removed. Furthermore, the signature given by the trusted party running the gateway allows a verification of the content. The transfer information that is also included as well as the HTTP-Headers enables the reader to reproduce the original request that resulted in the available local copy of the document. Therefore, our service helps to preserve the worth of online references and could solve some of the problems mentioned in [22].

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Exploring the Changing Face of Higher Education: Instructional Technologies, Distance Education & Adult Learners

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Abstract: Increasingly, college students are intrinsically motivated, non-traditional, adult learners. Learning must fit into already full lives. The traditional "sit-in-a-classroom-three-times-a-week-for-a-50-minute-lecture" does not generally meet these learners' needs. Celli Sarasin, discussing Zemke (1995), states that "facilitation has proven to be more effective than lecturing" (1998) and identifies active learning strategies that may be used to assist students in constructing knowledge. Increasingly varied and complex instructional technologies are available to assist in creating knowledge or in facilitating learning. These tools may enhance instruction or may detract from it. They may be the end or may be the means to reach the end. Tools may broaden educational possibilities or may frustratingly close the door to possibilities. This paper explores how – and whether – higher education is changing to meet the learning needs of adult learners, and the role that instructional technologies and distance education play in learning for this population.

Discussion

Traditionally, higher education has been instructor-centered and in many classrooms, virtual or physical, remains so. In this environment, the student is a passive receiver of information rather than being an active participant in the learning process. Bruner's theory of constructivism states that learners construct new knowledge by building on prior knowledge and by taking an active role in developing and testing hypotheses (Kearsley 1999, Campbell 1999). This learning mode actively engages the student.

Active learning involves discussion and risk-taking to build knowledge. It engages learners in problem-solving and encourages collaboration. Since learning intimately involves the learner, it is important to understand how each learner best learns. In fact, Boschmann, in the preface to *The Electronic Classroom* (1995), says that education must be personal and adapt to the learning styles of individual learners. Active learning, therefore, is advanced when both learners and instructors understand the variety of ways in which learners learn.

Understanding that learners approach learning and create knowledge differently can be particularly important for adult learners who may not have participated in formal education for some time. For these learners, most of their understanding of formal education will have come from an instructor-centered, auditory learning environment – the traditional classroom. Understanding learning styles becomes even more important in distance education where traditional educational norms may not exist.

For learners who prefer to learn amidst strong group dynamics and interpersonal relationships, distance learning may be a less comfortable environment than learning in a classroom where body language exists to supplement other information sources. In the distance environment, participants may be "face-less," known only by usernames and may, at first, appear without personality as well. Learners whose backgrounds include only strong instructor-centered education may flounder while waiting for instruction from an instructor who is now in a facilitative role rather than lecturing. Likewise, learners with strong auditory learning styles often find learning less effective reading text on a screen and may need guidance in locating and using other resources.

Numerous inventories exist, both online and in print, to help learners determine their preferred learning styles. Some inventories help learners understand whether they learn most effectively by listening, by seeing, or kinesthetically. Others provide insight into where and under what conditions they feel most comfortable learning and may include such variables as temperature, seating arrangements, lighting, noise level, and time of day (Dunn 1997). We know that it is possible, of course, to learn using non-preferred learning styles; however, learning using a preferred style makes learning easier (Celli Sarasin 1998). Learners may find that some of their discomfort in formal education environments stem, in part, from being required to learn in a style that does not suit them.

Instructors may find it beneficial to begin new courses by asking each learner to complete a learning styles inventory (Bash, Lighty & Tebrock 1999). Generally, only the learner sees the inventory results, but instructors often find it useful to request permission to also view the results. Knowing the representative learning styles of a class allows the instructor to incorporate a variety of learning activities into the instruction that will help the learners in that class. Campbell (1999) identifies different types of active learning techniques, such as simulations, conferencing, role-playing, or problem-based scenarios that may be employed to reach a variety of learning styles. This variety of activity also helps students to strengthen non-dominant styles of learning.

Many individual instructors are recognizing the importance of learning styles and are developing strategies to help learners meet their educational goals using a preferred style (Boschmann 1995, El-Tigi & Branch 1997, Bash, Light & Tebrock 1999). These instructors encourage each student to know his/her own learning style and can assist learners in constructing knowledge using tools that best fit the preferred learning style. However, both learners and instructors find that techniques that were used effectively in the traditional classroom may be more difficult or currently impossible in distance education. The field of interpersonal communications, for example, which relies heavily on body language, voice inflection, and eye contact, is more challenging in a distance format where face-to-face interviews can not be conducted or demonstrations of personal space can not be created. Public speaking courses may be more difficult for students facing a camera rather than a live audience. Instruction in clinical techniques is also more challenging at a distance.

Fortunately, the variety and increasing capabilities of instructional technologies provide access to learning that could not happen otherwise due to danger, limited space, unrealistic costs, or too distant resources (Hazen 1992). For example, highly sophisticated, programmable dummies are being used successfully for medical students to learn sensitive and complicated medical procedures. When programmed with detailed variables, they provide a richly varied learning experience that closely details what the students would encounter while working with humans. This tool allows learners to make errors in procedures or diagnoses with no detrimental effects. It also provides learners in remote areas, where there often is not easy access to sophisticated medical equipment and laboratories, with the ability to learn, often under tutelage of a skilled professional viewing the procedure via video. In addition, a growing number of web sites are now available that allow access to simulations, problem-based learning, virtual diagnoses, and virtual medical procedures.

In addition to providing different types of learning experiences, it is also important for instructors to incorporate multiple channels of access to instruction (Lamb 1992). Multimedia, for example, which incorporates sound, text, video, or still images, allows learners to choose the best method for them. Channels may also incorporate conferencing, personal interviews, and guided research. It is important, though, to build learning activities in such ways that learners are not penalized for choosing, or not choosing, a particular channel. Recognizing that learners have different learning styles and providing instructional materials in a variety of formats, places the responsibility of learning, of deriving meaning from information, and of constructing knowledge, back on the learner helping to create a student-centered environment (El-Tigi & Branch 1997).

Unfortunately, as recently as 1997, the Commission for a Nation of Lifelong Learners found that "many current higher education practices are ill adapted to the needs of employers and adult learners. They pose barriers to participation, including a lack of flexibility in calendar and scheduling, academic content, modes of instruction and availability of learning services…". Many educational institutions are now beginning to find ways to eliminate some of these barriers. They offer flexible schedules, provide online academic advising, and allow remote access to bursar and financial aid resources. Academic advisors and technical support are available for extended hours, particularly at peak times such as course scheduling periods. Bookstores encourage the purchase of textbooks online or via postal mail.

New York's Regents College implemented a web-based peer network to provide not only course-based resources, but to provide social resources as well. On the network, students can exchange books, socialize, mentor or search a membership directory to find co-learners. Students specify, via an electronic "permission slip," for what type of situations they may be contacted by peers or faculty. Regents' staff members may facilitate chats and monitor threaded discussion forums to identify "at-risk" students. If the student has previously granted permission, he or she may be contacted and offered appropriate services (Brigham, Bonesteel, Gabrielsen & Peinovich 1999).

This "just-in-time" education makes possible successful life-long learning for adult learners who are sandwiching education among other myriad activities and responsibilities. It also allows learners to take advantage of education opportunities they might not otherwise have had access to. Regents believes that what a person knows is more important than where the knowledge was gained or from whom. It has no college campus and offers no courses. Yet, through distance learning technologies, over the last 25 years, it has conferred accredited associates and baccalaureate degrees on over 80,000 adult learners based on their life experience and previous college work. Only about 15 percent of Regents' graduates are from in-state (Regents 1999).

In his article on life-long learning and technology, Green states that "we are participating in a steady process of evolution and change" in higher education technology transformation (1999). This transformation has enabled a steady increase in the number of available distance education opportunities. The 1994 Peterson's Guide to Distance Learning Programs identified 93 institutions that offered distance learning courses. Six years later, the Guide lists 878. Robert Tucker of the Arizona-based higher education research firm, InterEd, estimates as much as 90% of the 2,267 four-year colleges and universities will have distance learning courses by the year 2000 (Gubernick & Ebeling 1999).

This is good news for those seeking a post-secondary degree since the costs of receiving an on-campus degree continue to soar. For example, a student taking 120 credits for degree completion through the University of Maine System Network's on-campus program would pay nearly $37,000. The U of M online program, however, allows the same student to pay a little over $16,000 for the same degree. This represents a $20,000 savings in completing a degree online compared to on-campus (Gubernick & Ebeling 1999).

University programs such as Indiana University's School of Continuing Studies are moving complete programs online to better serve the needs of their students. It is now possible to complete the course requirements for a Master of Science in Adult Education from Indiana University without stepping foot in a traditional classroom. In most cases, however, distributed education is supplementing rather than replacing traditional courses, resulting in an environment that Kenneth Green of the Campus Computing Project calls "high tech, high touch" (Olsen 1999).

High tech instructional technologies used in distance learning include many "high touch" communications tools that enable extended communication. Synchronous "real-time" chats, electronic mail (E-mail), and discussion forums (conferencing) allow communication on a multitude of levels. Ehrmann (1995) points out that with distance learning technologies, connections can occur between students, between faculty and students, and between faculty, students and distant experts. Experts often are accessible to learners via E-mail and are willing to correspond with them, sharing insight, expounding on research findings, and discussing career possibilities.

Cohen's and Trocco's experiences in a U.S. residency program found that communicating electronically allowed participating Saudi women to develop – often for the first time – their own "voice." The women were able to explain to their co-learners many of the norms of Saudi culture and the lack of "voice" for women there. As intimacy increased among class participants and the women were able to explain about culture and gender differences, it altered prejudices that had previously existed among the class members (Cohen & Trocco 1999). Bellman (1992) found that electronic communications often are a way to improve critical thinking and promote learning, as well as lessening distance between students. Furthermore, physical limitations and gender differences may also lessen in electronic environments. Barnard (1997) found that student responses were more thoughtfully composed in the electronic environment and that students who would not likely be participants in a face-to-face classroom are willing participants online.

In many online courses, students have assignments that require them to explore the Internet to find resources pertinent to their field of interest. These resources may then be posted in the course to share with co-learners. Students often write reflective essays or critiques describing the merits of these resources. Distance education also allows access to CDs, audio and video resources, and co-learners around the world (Baird & Manson 1992) to create a resource bank more vast than any one university or college could have provided solely within its own boundaries.

Conclusions

With this research, I confirmed that there is broad awareness of the field of learning styles among educators, and that educators in the field of adult education are knowledgeable in adult learning theory and life-span development. We know that education becomes more effective when it is student-centered – "What do you want to learn and how can I help you reach those goals?" – than when it is instructor-centered – "I know what you need to learn; I have that knowledge, and I will teach it to you." Instructional technologies play an important role in student-centered education, particularly in distance education where they enable "just-in-time learning." However, instructional technologies, whether distance or not, are not a panacea for every ill of education. Applying a technology band-aid in any form can not fix what might be broken in education. It is a tool, and like all other tools, can be used to fix things or to break them further. It should be the means to achieving educational goals, not the goal itself (McLellan 1996).

Buying and installing technology is easy; integration into the teaching and learning process is the challenge (Lamb 1992). Utah's governor, Michael Leavitt may state it best: "Higher education ought to be focused on content, not hardware" (Carr 1999) – thus, taking us back to student-centered learning.

Distance learning makes possible connections that otherwise would not have been easily made; instructional technologies, particularly the number of communications channels, enable communications that might not otherwise have occurred. Technology can be both "high tech" and "high touch." No matter what role they play, instructional technologies can not be overlooked or ignored by higher education. These tools must be explored and incorporated, as transparently utilized, as pencil and paper are in taking class notes.

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Mobile Distributed Telemedical Care System on top CORBA and Cellular Radio Network

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Abstract: A mobile distributed care system is developed for support of patients with brain disturbances and tested in the daycare clinic for cognitive neurology at Leipzig University. The system is based in the wired network on a platform independent implementation using object-oriented architecture, Corba/Java and Internet/Web based technologies, e.g. control and data structures (WML, MML) and protocol stack (HTTP, MTP, TCP, IP). The mobile device, a special palmtop-size computer with touch screen, is connected bidirectionally with the base station via cellular radio network (e.g. ETSI/GSM). To allow disabled persons the use of the mobile device, a patient suitable interface with an integrated voice emergency call is developed. In the contribution the functionality as well as the application conditions in the practical care of patients are represented.

Keywords: mobile distributed computing, CORBA, IIOP, WWW application, cellular radio network, bidirectional pager, neuropsychology, telemedicine, telerehabilitation

1 Introduction

Memory disturbances are a frequent outcome of brain damages. Maintenance or enhancement of the patients life quality often requires an enormous effort of caregivers or family members. Modern information technologies offer efficient conditions in medicine and neuropsychology combining communication techniques with psychological methods. The use of bidirectional pagers enables the therapist to supervise and manage the actions of brain damaged persons even outside the clinical setting thereby being assisted by the patients family members.

The distributed care system is based on Corba/Java, which uses mobile palmtop-size computers to support head injured persons in solving real life tasks, by reminding them of essential facts and dates. About the IIOP interface (Internet Inter-ORB Protocol) the services of WWW can be used. It is one of the first time in clinical neuropsychology, that a bidirectional communication with mobile patient devices via radio connections is used. So it is possible, to observe the patients actions and to react immediately. Experiments with commercial unidirectional pagers showed, that the use of paging devices for telerehabilitation purposes is suggestive, but the backward channel to receive confirmations about the patient actions is necessary for professional treatment of memory disturbed persons (see Cole 1999 & Kopp et al. 1999).

The object-oriented architecture of the proposed care system allows the realization of an extensible, scalable and fault tolerant system. Using generic control and data structures ensures, that the system is applicable to a broad class of operation scenarios without any adaptions at source code level. Corba as middleware platform guarantees efficient software development on heterogenous hard/software without using proprietary software and allows an easy extension of the system by adding new server objects or user interfaces for different therapists as well as for family members, which can support the patient. The patients are equiped with a specific palmtop-size computer. Because of energy reasons the palmtop is connected only some minutes a day with the care system. The other time it has to work disconnected but can always call the base system every time in case of emergency. The user interface is adapted to the patients restricted abilities.
For the wireless connection between the mobile device and the care station in the fixed network serves a cellular radio network, in our case based on the standard GSM (Global System for Mobile Communications), standardized by ETSI (European Telecommunications Standardization Institute). On this communication bearers the well-known Internet/WWW protocol stack PPP, IP, TCP, HTTP is applied. For the mobile access, a data structure like WML (Wireless Markup Language) is used, which allows also the mobile access to the Internet

and via IIOP to the Corba-based care region. For realization of the functions a special script oriented specification language MML (Mobtel Markup Language) and an appropriate transfer protocol MTP (Mobtel Transfer Protocol) are developed, both analogous to WML resp. HTTP in the Web architecture (see Fig. 1).

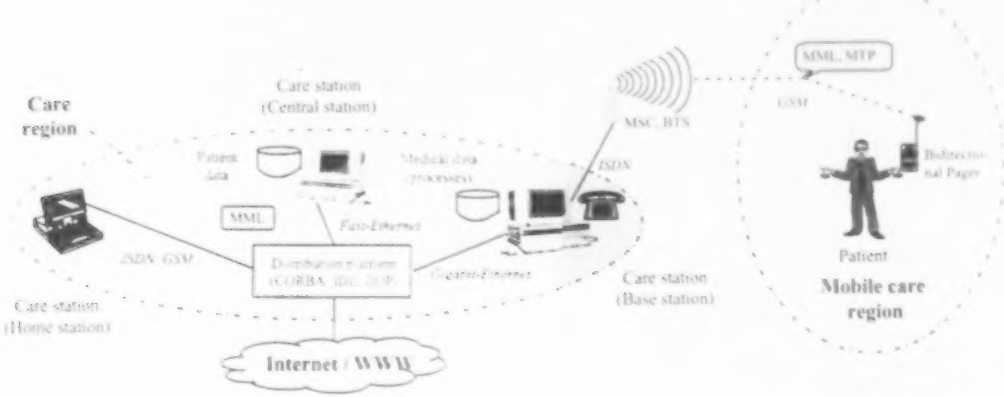

Fig. 1: Distributed telemedical care system with mobile equipments (bidirectional pager)

The implementation follows by an interdisciplinary project, called Mobtel, in co-operation with different partners at Leipzig University (Chair of Computer Networks and Distributed Systems and the Daycare Clinic for cognitive Neurology) together with Max-Planck-Institute of Neuropsychological Research at Leipzig and RBM electronic-automation GmbH Leipzig (see Irmscher et al. 1999).

2 Architecture

2.1 Requirements of a Mobile Care System

Memory disturbances are besides attention deficits one of the most common sequels of brain damages. To compensate these deficits external memory aids like calendars or memory books have been used. However, the use of external aids has often failed due to several difficulties inherent in patients functional deficits. Modern electronic timer or organizers on the other hand are too complex in design and handling, so the patients are not able to learn the use of such an external device. Therefore, there is a strong need for an interactive external memory aid. The proposed care system enables the caregiver to survey the activities of a patient. The patient also has the opportunity to call for help whenever he doesn't succeed in managing a situation on his own. This bidirectional data exchange is basis of the relative young research area of telerehabilitation (Rosen 1999).

Main focus is the development of a distributed heterogenous system which considers especially the needs of the brain disturbed patients, the unreliability of mobile communication, the limited resources of the mobile device and a heterogenous care region. Furthermore, the base system provides the basic services in the fixed network, which can handle the unreliable connections to the palmtop, which is extensible to new neuropsychological methods, scalable and fault tolerant. With the Corba architecture the possibilities are given for heterogeneous systems as well as the connection to Internet and Web services using the IIOP (Internet Inter-ORB Protocol) facility.

The interactive care of brain injured patients requires an online connection between caregiver and patient by mobile communication and therapy services. The WML-like data structure MML serves for mobile access to the care services, prepared automatically by the care station in the fixed network (taskplans). This architecture also can used for mobile access to further services on special Web servers, similar to WAP technologies decribed by WAP forum (Wireless Application Protocols).

2.2 System Overview

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The major requirement we had to consider during the development of the architecture was the bidirectional communication between the therapist and the patient using mobile telephone technologies. By reason of the unreliability of mobile communication, this has two consequences. The mobile patient device has to work independently from the base system, and the base system needs a pager proxy object (pager object) for every pager, which stores all necessary information for the pager. During every communication, the pager object reads the logfile of the pager and updates its internal state.

For disposal of Internet contents on mobile platforms the language standards WML (Wireless Markup Language) and HDML (Handheld Device Markup Language) are developed. Both are action- and event-oriented structured and matched to HTML (HyperText Markup Language). WML is a tag-based document language, defined with XML (eXtended Markup Language) and considers the device resources are limited (diplay size, storage, power). A HTML page in WML is called a "card". Near by can be distingushed into display cards (for notice), choice cards (for choice) and entry cards (for input, generally text oriented). Several cards within a WML document are collected as a "deck" and transmitted summarized. The in WML formated documents are kept on corresponding servers and can be transmitted via an air interface to the user agent (browser) on the mobile end device and there displayed with a micro- or WML-browser.

Since existing markup and scripting languages like HTML/JavaScript or WML (Wireless Markup Language) are not applicable to our system, because they are either too complex or too simple, we developed a special markup language (MML - Mobtel Markup Language), which enables a partial autonomy for the pager, but is not too complex for mobile bandwidths, and a simple transfer protocol (MTP - Mobtel Transfer Protocol) on top of TCP, which considers the special features of the proposed architecture.

Analogous to WML a set of linked cards is called a deck. Every task a patient has to solve consists of one or more decks. At the mobile level the pager only knows decks and cards, but on the base system and user interface level we only consider tasks. The data structure for tasks forms a graph (taskplan). For every activated task a proxy task object is created, which manages the creation of the corresponding MML-description, the transmission to the palmtop and supervises the status of the task on the palmtop by analyzing the pager logfiles. If a critical state is reached, the pager object sends a message to the caregiver, using SMS (Short Messaging Service), email or a simple pop-up window.

2.3 The Mobile Device

The pager should be usable for patients with cognitive deficits, so it must be fault tolerant and very easy to handle. The ergonomic design is very simple, we only have two hardware buttons. All other interactions are performed using the touchscreen. With the GSM module a voice or data connection can be established. The voice connection is used for emergency calls to the therapist or to make appointments with a caregiver. The data connection is used to send new tasks to the pager, to update or delete tasks and to receive logfiles from the pager.

A major problem in the development of the patient palmtop is the standby time of the device. If the base system requests a communication to the palmtop, a message will be sent using the Short Message Service (SMS) of the cellular radio network. If a SMS message arrives requesting a connection or other reasons for connecting the base system, the palmtop connects to the base system and establishes a TCP/IP connection using PPP (see Black 1995 & Walke 1998). The functions and protocols used are supported by the operating system Windows CE for the interactive pager device.

2.4 The Base System and Graphical Interface

For realization of the main functions the distribution platform Corba as middleware and Java as programming language are chosen. So, the base system can be described as a set of Corba objects distributed to several computers. To store data an object-oriented database is used, which works together with the persistence facilities of Corba [Orf97]. Additionally, Corba secures with the IIOP interface (integrated in ORB kernel) the connection to Internet services. The Corba architecture used in the system is shown in Fig. 2.

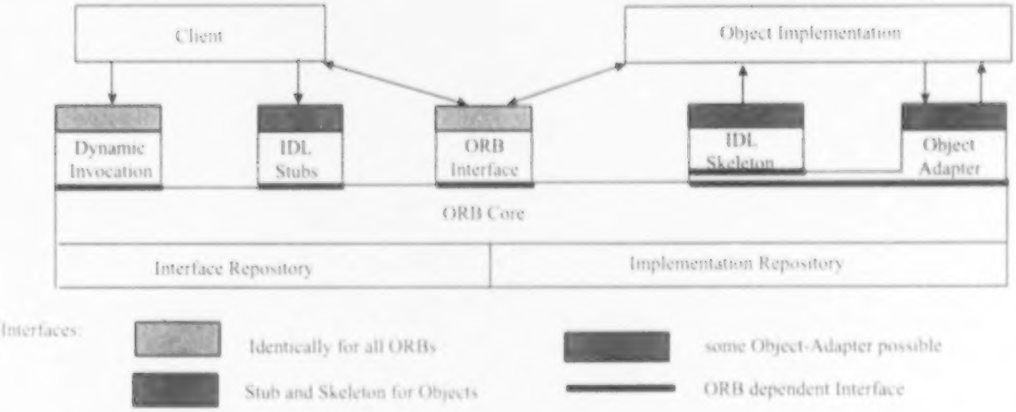

Fig. 2: CORBA (Common Object Request Broker Architecture), Components and Interfaces

The connection to the mobile patient devices are established by a special server (pager gateway). This gateway is a Corba object for the base system as well as a socked based server for the palmtop. If the palmtop connects to the gateway it asks the gateway for a list of new or updated decks and loads down all MML files for these decks. Such MML files can be stored by the pager gateway or they are created dynamically. Therefore the gateway connects the corresponding pager proxy object.

The user interfaces are designed as thin clients. This approach has several advantages. The business logic is implemented only once a time. Adaptions can be done without changing the user interfaces. The user interfaces are implemented as Java objects and connect the base system using its Corba interfaces, other user interface types as Java applets or a Web interface using servlets, Java server pages or CGI scripts (Common Gateway Interface) easily can be implemented. In further steps also the mobile access to Web-based services via portals will be taken into account.

3 Realization of the Base System

3.1 The Distributed Model

For implementation of the base system each real world entity (e.g. patients, mobile devices, tasks) is represented by a proxy object. These objects are Corba objects and they communicate with each other using their interfaces. Every object is responsible for its real world entity. Additionally, some management objects and Corba services coordinate and simplify the cooperation of the object world. So, switching between analysis and design in the software development process is quite easy using UML (Unified Modeling Language), and the model can be easily extended or adapted to future requirements. Using a large number of Corba objects, they can be distributed to several computers to spread the work load and increase the throughput of the base system. With the capabilities of the Portable Object Adapter (POA) it is possible to realize a dynamic load balancing over all computers involved (Gamma et al. 1995 & OMG 1998).

3.2 Pager Object and Tasks

Pager Object and tasks are the main components of the architecture. Every pager object is responsible for one mobile patient device and manages the state of this device. The pager object handles every communication with the palmtop. Since the mobile device is mostly disconnected the pager object stores the newest known state of the palmtop. On the other side the pager object manages all assigned tasks. So the pager object recognizes two contradictory tasks and refuses one of them or reorganizes the scheduling of the tasks.

A generic data object and a taskplan object is assigned to every task object. With the data object and taskplan the task object can create the MML description of itself. The MML description of the task will be commited to the pager object and registered at the pager gateway. If a mobile device connects to the pager gateway, the pager gateway requests all registered MML files from the pager object and transmit them to the palmtop.

At the beginning of every communication between the pager gateway and the mobile device the logfile of the palmtop is transmitted. The logfile entries are evaluated by the pager object, which transmits them to the corresponding task object. Here the task object updates its state. If a task is in a critical state, a message will be sent to the therapist.

3.3 Co-operation of the Server Objects

A typical scenario for the use of the base system could be the creation of a new task for a patient. The therapist will use the therapist interface and selects a taskplan in a list of available taskplans for the patient. The taskmanager creates a new instance of a task object. The task object attaches the taskplan and creates a data object. With the information stored in the taskplan the task can be adapted individually by the therapist to the patients needs.

The edited data are stored in the data object. The MML description of the task can be created with the data of the data object and the taskplan. Additionally, the task calculates the time the patient needs for it and tries to reserve this time at the pager. In this way a caregiver for the patient knows about the patient schedule and if two tasks collide the second task has to start at another time. If a task is registered at the pager object, the pager object informs the gateway about the new available task. During the next communication between the patients palmtop and the base system, the gateway requests the MML description from the pager object. The pager object asks the task object, and the task object creates the necessary files, which are uploaded to the patient device.

3.4 Technical Issues

Although the system works on a single computer, experiments have shown, that the base system is more efficent, it is implemented on more than one computers. The first is the pager gateway (Linux server), which manages the telephone connections. Linux supports currently up to 4 ISDN cards in one computer, using the AVM C4 ISDN card with 4 base connections on every card, we can support 32 connections at time.

For stability and performance reasons the database should run exclusive on a server, connected by a fast network. To use the Corba persistence capabilities, POET is used, a object oriented database for Java 6.0. A further computer is employed as server for the base system core. Depending from the number of patients the Corba objects could be distributed to a computer cluster. Since using Java 1.2 and Corba, we are independent from a special operating system and can support Linux, Windows and Solaris.

4 Telemedicine - Use in Neuropsychological Therapy of Patients with Memory Disturbance

The prototypically developed mobile and distributed care system is evaluated at the daycare clinic for cognitive neurology at Leipzig University. Trial persons are equiped with the bidirectional palmtop-size equipment. The base system is located in the clinic and connected with the mobile devices by ISDN (Integrated Services Digital Networks) and radio telephone connections using the ISDN/GSM gateway of a telephone provider. The stationary care system in the clinic can be extended with further care stations (e.g. home station) about the Corba bus. Therefore, the additional care stations have to establish an ordinary Internet connection.

The treatment methods for patients are the content of taskplans, realized by tasks of the base station. A typical task is the reminder to take up a certain medicine, for example. Medicine used in the treatment of brain injured persons often has to be taken up in very strict intervals. If the patient forgets to take up this medicine the success of the therapy might be critical. Moreover, for the caregiver it is necessary to get a feedback about success or failure of the actual action. By combination of different cards activities can be realized, described in the taskplans. A typical example is shown in Fig. 3.

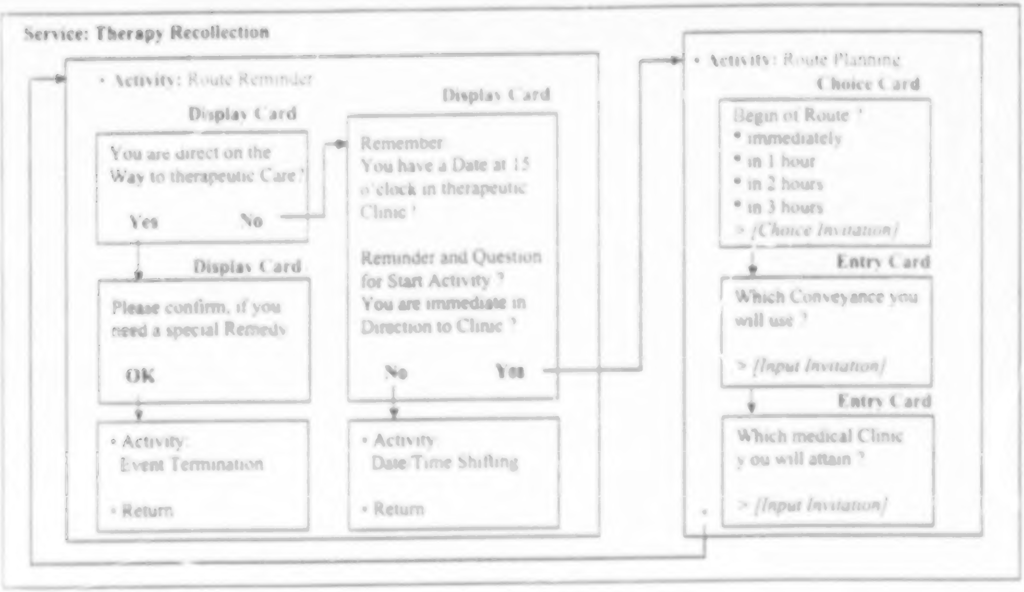
Service: Therapy Recollection
• Activity: Route Reminder
Display Card
You are direct on the Way to therapeutic Care ?
Yes
No
Display Card
Please confirm, if you need a special Remedy
OK
• Activity: Event Termination
• Return
Display Card
Remember You have a Date at 15 o'clock in therapeutic Clinic !
Reminder and Question for Start Activity ? You are immediate in Direction to Clinic ?
No
Yes
• Activity Date/Time Shifting
• Return
• Activity: Route Planning
Choice Card
Begin of Route ?
• immediately
• in 1 hour
• in 2 hours
• in 3 hours
> [Choice Invitation]
Entry Card
Which Conveyance you will use ?
> [Input Invitation]
Entry Card
Which medical Clinic you will attain ?
> [Input Invitation]

Fig. 3: Taskplan for recollection of different petient activities

A more complex task is to lead the patient to a meeting using public transport with a change in between. Such a task starts with a pre-alarm, informing the patient, that he has to prepare mentally and practically for the actual job. When the patient has to leave home, the palmtop will remind him of taking needed things with him, like the keys or money. While it is not important to confirm the pre-alarm, the final alarm with the reminders has to be confirmed. A real critical situation is the moment of changing the tram or the bus because there are a lot of possibilities to fail and the correct state of the patient cannot be tracked in every case. It is impossible to consider all possibilities of such a complex task. Therefore it is important to test which class of brain injured patients can complete such a difficult task.

For evaluation the care region at first within the department of medicine and the base station in the daycare clinic for cognitive neurology are installed and selected patients are equiped with mobile interactive pagers. First experiments show good results by use of of the intelligent equipments. Statistical secured results of validity of the complete care system will be available at the end of the neurological test phase. Besides the functional tests of the care system, new therapy methods are developed to prove it with the care system. Furthermore, the acceptance of the system and especially of the mobile device is tested at patient classes with different mental disturbances. Generally, new scenarios for use in telerehabilitation are investigated and developed.

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Online Testing and Grading Using WebCT in Computer Science

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Abstract The following paper reports on an experiment with online testing and automatic grading in a large, undergraduate computer science course in artificial intelligence. WebCT was used to construct, administer, and score a midterm examination made up of randomly selected items from an item bank. Disciplines in which timed, selected-response exam questions are used for assessment and evaluation of large enrollment courses may find the WebCT online examination environment useful for future course offerings.

Rationale for Online Testing and Grading

The context in which this experiment took place is the Computer Science Department at the University of Calgary, which accepts 150 undergraduate students per year at the second-year level of a four-year program. Interest in innovative testing methods is motivated by the department's mandate to triple the number of students it accepts within four years. A worldwide shortage of, and very high demand for, qualified instructors in CPSC compounds the testing and grading problem and we anticipate increased pressure on course instructors with respect to expansion of computer science because of increased numbers of students, larger class sizes, and more sections of courses.

The course in which the experiment took place is a fourth-year elective introductory course in artificial intelligence (AI) that surveys a large number of topics. Student investigate particular topics (based on text chapters) in dyads or triads and present their findings to the larger class, and post their work on the web. The course outline, all course materials, and student web notes can be found at **http://sern.ucalgary.ca/courses/cpsc/531/w99/.** The course was divided into two simultaneous lecture groups where different groups presented the same material. All students had full access to all course materials, including students' web notes in the other lecture section of the course. There were approximately 130 students registered in the course, equally distributed between the two lecture sessions.

The instructors had previously used short answer and paragraph answer examinations due to the perceived difficulty of setting multiple choice questions for the type of content covered in the course. However, the burden of grading short answer and paragraph answer items for a increasingly large class motivated the trial of an on-line, multiple-choice exam tool. The instructors chose to investigate on-line examinations over using more traditional machine scored formats (i.e., scantron sheets) because on-line exams have the potential to blend multiple choice, matching, short answer, and essay items in one exam. The instructors viewed mixed scantron and essay answer sheets as confusing for the students and a potential administrative problem for large classes. On-line exam environments, such as WebCT's, allow more automation of the marking process and more timely results; marks can be automatically displayed to students immediately upon completing the exam.

The decision was made to construct and administer the midterm examination as a completely automated WebCT form using multiple choice and matching questions, and present the final examination, made up of short answer and essay type items, using traditional, in-class administration methods. The rationale for experimenting with a web-based examination methodology is to automate more of the multiple choice examination and grading process.

WebCTs Testing Tools

WebCT is a web server designed to support on-line, web-based instruction. Faculty with little or no prior experience with HTML will find the inherent structure and design of WebCT to be useful starting points for creating online documents. The tool sets offered by WebCT provide valuable entry-level supports and templates as one creates course materials and online examinations. An extensive summary of our evaluation of WebCTs features is available online (Jacobsen, Wijngaards, Kremer, Shaw and Gaines, 1999). In brief, WebCT offers encapsulation and paths through existing course content, student presentation areas for groups of students, individual student tools for note-making, and a chat facility for synchronous, online discussions. WebCT was chosen for experimentation for a number of reasons, including free testing of WebCT with full functionality, inexpensive licenses, a large customer base, proximity of developers, ease of access via common web-browsers, and ease of customization (if needed). In Spring 1998, WebCT was installed on a local server so we could experiment with many of its features. This led to enough confidence in WebCT for its use with a local and distance graduate course in Fall 1998, and a distance graduate course and testing for an undergraduate course in Winter 1999. The technical support person and a course instructor were well versed in HTML, scripting, and other computer-related activities which influenced the evaluation and usage of WebCT. Based on experiments using WebCT to construct and administer graduate courses (without examinations), the following observations have been made:

- Support by the developers is very good. Queries and requests were dealt with quickly and to our satisfaction.
- It is easy to (a) install WebCT (beta 1.3 on Windows NT took slightly more time than 1.2 on Unix), (b) create courses as an administrator, and (c) encapsulate existing course material.
- It is moderately difficult to get used to all of the WebCT concepts and develop a mental map of the course structures, and to keep information up-to-date in a course, because the tool imposes a certain approach to structuring on-line course materials. One must become familiar with the affordances and constraints inherent in WebCT's design in order to construct well-organized course materials.
- It was difficult to customize WebCT to add connections to the external list server; Perl scripts had to be modified to add a mailto: hyperlink (referring to the list server) to WebCT's common button bar

WebCT presents all user types (i.e., administrators, course authors, instructors, markers, students, and so on) with hyper-linked course selections, and then an icon page of course tools customized to the selected course and user type. Students can view course outlines and various types of web pages, view their progress though the course, post assignments, complete questionnaires, and take practice and real exams. Course instructors can post course web pages including examinations, edit question banks, view students' progress though the course, view student statistics such as connection time and examination results, and view and mark students' submitted assignments. Using a web browser, students access the WebCT server by linking from the course web page. Students can then enter answers to multiple-choice examination questions, which are graded automatically. As students complete the examination on-line, their graded examination data is saved to formatted file that the instructor can further analyze and manipulate. In addition to grading, the WebCT environment offers item analysis and statistical analysis and graphing features. From our experiences using WebCT to construct and administer a midterm examination, the following observations have been made:

- WebCT question banks and examinations for multiple choice, matching, short answer, and essay questions are relatively **easy**, though somewhat tedious, to construct.
- Multiple choice and matching exam items can be accurately marked by the automatic grading system.

Considerations for Online Exam Design and Administration

Although WebCT offers short and long question styles, the selected-response type items were chosen in order to take advantage of the automatic grading feature in WebCT. Exam questions were either multiple choice or matching items. We chose not to display the students' grade immediately upon completion of the midterm to discourage potential cheating. There was no penalty for incorrect answers, so if time was running out, it was in the student's best interest to guess at the remaining exam items. The exam represented a considerable amount of instructor preparation time, but, since grading was done automatically, the marking time was essentially reduced to zero. WebCT provides handy statistical and graphical summaries of group results, as well as a complete item analysis. Instructors will find this summative information useful in analyzing student results and the "discrimination" performance of each item on the examination. While the additional preparation time for this type of exam would probably not recommend it for class sizes of less than 40 students, the ease of marking and availability of detailed statistical results makes it a useful tool for large class sizes. If statistical results are used in conjunction with a question bank (also supported by WebCT) and selected questions are re-used in subsequent courses, then the adoption of WebCT may eventually result in time savings for instructors of large section courses, and improvements in test item construction. Support was provided during the entire exam period by the two course instructors on campus, who were available by phone, and a network manager in case there were WebCT server difficulties.

Table 1: Level of agreement with statements about taking an online exam (prior to exam).

	Percentage					Mean	SD
Statement	**SA**	**A**	**N**	**D**	**SD**		
I like the idea of completing the midterm examination on-line because it gives me choice and flexibility in my participation (i.e., any time, any place, any location).	25.3	38	18.3	7	11.2	2.41	1.26
I am comfortable with the idea of taking a web-based, on-line midterm examination.	12.6	47.8	19.7	8.4	11.2	2.58	1.16
I am worried about taking a web-based, on-line midterm examination.	15	28.3	23.3	23.3	10	2.85	1.23

Exam Construction and Preparation

For this administration of this exam we constructed a test bank of 51 items from which 33 questions were randomly selected when the student logged in. Some questions were chosen from groups of unique items and others were variations of the same question. The instructors can easily add to this test bank for subsequent sections of the course. A feature of WebCT is that exam items are randomized only once per student. In the event that a student experiences a technical problem, such as a broken network connection, they would be able to log in again and continue at the point they left off. A potential drawback is that the timer keeps ticking while the student is disconnected; however, this "security" feature prevents students from purposely experiencing "technical failures" during the exam so they can distribute copies of the questions, or work out answers and reconnect later.

It is critical to provide opportunities for students to practice with the exam interface prior to the actual exam. Thus, we invited students to complete a pre-exam survey that used a similar interface to the actual exam (i.e., selected response and open-ended response items). The survey gathered information about students' prior online exam experience, expectations, and concerns. The pre-exam survey also served as practice with logging in and changing passwords prior to the exam date. Some students reported feeling unduly pressured by the time constraints during the actual midterm. A few students mentioned that they were very aware of the timer during the exam (there where no time constraints on the survey). Thus, before a high-stake online midterm or final exam, it may be beneficial to expose students to some short, timed quizzes in WebCT to familiarize them with WebCT's examination timer.

Student Profile

The majority of students are registered in their fourth (36.6%) and fifth (33.8%) year of undergraduate studies, and over 75% of students are taking 4 or more courses per semester. The gender ratio is four male students to every one female student, and over 90% are between the ages of 18 and 29 years.

Perceptions of Online Testing Prior to the Web-based Midterm Examination -- Students were asked to indicate where they planned to complete the online midterm exam. Most planned to complete the exam using computer facilities on campus (56%); some planned to use their home computer (31%); a small number planned to complete the exam at their workplace or office (5.6%) or some other place (7%). For the majority of students (97%), completing a course-based online midterm examination was a novel experience. In response to pre-exam survey about their preferred method of testing, 49% of students indicated that they would choose on-line, web-based exams, while 45% said they would choose an in-class, pen and paper examination. Students used a five-point scale (i.e., 1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree) to indicate their level of agreement with three, first-person statements. Table 1 summarizes the responses to these statements.

Prior to the exam (Table 1), the majority agreed that they "liked" (63.3%) and were "comfortable" (60.4%) with the idea of an online midterm exam. While 33.3% disagreed that they were "worried" about the exam, there were 43.3% of the students who were worried. Prior to taking the exam on-line, students were asked to consider the potential benefits and drawbacks to web-based testing methods. Students expressed a range of opinions about the potential benefits of on-line testing, from "increased time and location flexibility", "faster grading and feedback", "convenience for both student and instructor", "access to resources (i.e., open book exam)", to "comfortable

Table 2: Student opinion about design of the user interface (after exam)

Statement	Percentage					Mean	SD
	SA	A	N	D	SD		
I found it easy to locate and view questions within the midterm examination.	19.6	53.5	16.0	7.1	3.5	2.21	.95
I found the navigational tools within the examination easy to understand and use.	21.8	50.9	18.2	5.4	3.6	2.14	.98
I found it easy to always know "where I am" within the midterm examination.	29.0	41.8	20.0	7.3	1.8	2.11	.96
Overall, I would say that the midterm examination web site is very user friendly.	19.6	50.9	15.6	9.8	3.9	2.27	1.01

environment (i.e., home vs. campus)". Students also described concerns about completing the midterm using WebCT, such as "effects of cheating", "possible technological failures", and "students might work in groups".

Student Feedback After Taking the Web-based Exam -- Students were asked to indicate the actual location at which they completed the online exam. The proportion of students who actually completed the exam on campus rose from the planned 56% to 65.4%. Almost one-third actually completed the exam at home (29%), a small proportion at their workplace or office (3.6%) or some other place (1.8%). A majority of students indicated that taking the on-line midterm examination did not change their attitude about on-line testing in any way (61.8%). Of the students who did report a change in attitude, the majority indicated that the online examination was **better** than they thought it would be (i.e., easy to navigate, ease of participation, no technical problems). A small number of students indicated that taking the examination strengthened their opinion that this is an ineffective method for testing (i.e., no instructor present for questions, worry about cheating, felt pressured by timer).

User Interface of WebCT Examination -- Students used a five-point scale to indicate their level of agreement with four, first-person statements about the design of the user interface for the examination (Table 2). Overall, the majority of students expressed high levels of agreement with all four statements.

After taking the midterm examination using WebCT, students were asked to describe the most important strengths/benefits of the on-line testing method used in the course. The most cited benefit was "anytime, anywhere" access, closely followed by "increased flexibility" and "convenience". One student wrote, *"It allows you to define the atmosphere in which you write the test. I like to listen to music while doing this, so had a comfortable area with my discman going"*. Other students also described their satisfaction with being able to choose the environment and conditions under which they wrote the exam. Students were also asked to describe the most important weaknesses of online testing. Along with concerns over cheating and limited access to the instructor for questions, a small number of students mentioned "no immediate feedback about results" as a weakness. This could stem from their knowledge that immediate feedback was possible using WebCT, however the instructor chose not to use this feature for security reasons. One student indicated a lack of trust in the interface: *"I went through the whole exam to double check that I had an answer for each question because I couldn't trust the information window on the right"*.

Students were asked to describe how the on-line midterm examination methods made it **easier** or **more difficult** to complete the examination. A large number of students indicated that online exams were better because they could type faster, or click on radio buttons faster, than they could write or fill in answers on a paper and pencil exam. One student wrote, *"It made it easier for me to write the exam from my parent's home in XYZ, Ontario, thus not interrupting my vacation plans"*. Some students indicated that the novelty of the exam environment made it harder for this first exam, but they expected that this effect would be less for the next online exam. One student who completed the exam in a campus lab commented, *"it was harder because there were more distractions than in a classroom where everyone is quiet because they are writing a test"*. The following excerpt effectively summarizes the mixed blessing that the online exam environment may be for students who would prefer to demonstrate their learning in alternate ways: *"The interface is excellent and easy to use, like any multiple choice exam. However, not being able to show my thought process before arriving at a definitive answer for a question bothers me. Although I may have a pretty good idea of what's going on, if I'm limited to choosing a number and being "right" or "wrong", I can't show what I know"*. It is critical, in our opinion, to offer more than one type of exam or assessment for a course so that students have a number of different ways to demonstrate their understanding of course concepts and topics.

Students were asked to describe any problems they had accessing the on-line midterm examination (i.e., location, technology, WebCT interface, and so on). The majority of students indicated that they had **no problems** accessing the web-based exam. Only one student reported a crashed browser, and that student was able to re-establish a connection and complete the exam with no further problems. Connectivity and bandwidth apparently affected the submission time for some students who reported that it took a number of minutes to save certain answers. However, this problem is unverified in our experiment, as the tests and retests that we conducted did not repeat this problem.

Students used a five-point scale to indicate their level of satisfaction with their performance on the midterm exam. The majority indicated that they were **neutral** (61.1%), which may be a measure of their uncertainty with the content of the exam or the method of participation. A modest proportion of students agreed that they were satisfied with their performance (16.6%), and a smaller proportion disagreed (12.9%). In response to a request to indicate their **expected grade**, however, students were very optimistic: 13.2% of students believed they performed in the top 10 percent of the class, 47.1% in the top 25 percent, and 39.6% in the top half of the class. No one believed they performed in the bottom half of the class! Overall student satisfaction with the on-line examination method used in the course was relatively high immediately after the exam: 49% of students were satisfied or very satisfied with the web-based midterm methods, 27% were neutral, and 22.9% were either dissatisfied or very dissatisfied. Students provided useful information on how participation in this type of on-line examination can be made easier and more convenient for future students, such as giving more practice exams prior to the graded exam, schedule designated campus areas for students to write the exam in (both for supervision and noise level reasons), and improving the wording of a few items that seemed ambiguous.

Student Performance Results

Almost all students completed the exam and most students achieved acceptable scores. An interesting result was that performance expectations were much higher than actual performance. A number of students were surprised by their grades, which were lower than they expected. There are a number of possible explanations for this result. The midterm exam was designed to be rather challenging to complete in the time given if students were not adequately prepared. Most items were designed to require application, analysis and synthesis of course content, rather than merely recalling or recognizing facts. Students who had attended lecture, participated in labs, and had read all assigned materials, had a greater chance of success in this exam. One reason for designing a more challenging exam was that it was open book. Therefore, we expected that students who studied for memorization or recall would not perform as well as those who studied and attempted to understand higher order concepts. If students tried to look up answers in the textbook, then they would not have had time to complete the entire exam. One item, worth 10%, required students to complete a lengthy calculation. It is unclear whether this question added "noise" or error to the exam results. Many students spent an inordinate amount of time on this question, and may have had to guess at other questions as a result. It may be better to divide the exam into two separately timed parts to mitigate the possible random effects of the two types of questions (long calculation vs. standard multiple choice). We believe that varied environmental conditions may have affected some students' exam performance. Students chose the time and location to write the exam Some students were concerned about slow access times from home, and therefore chose to write the exam at a public computer on campus. However, a number of students reported being frustrated by the noise and distractions in the campus computer labs. Therefore, students who did not have access to a private study area equipped with an internet-connected computer on campus may have been at a disadvantage.

Student Reaction to the Online Exam

Completing a midterm exam online was a novel experience for almost all of our students. A majority of students identified the flexibility of "anytime, anywhere" access as an important strength and benefit of the online exam. They liked being able to write the exam at a time most convenient to them. Students did not have to travel to campus for the exam; they could complete the exam using a web browser from home, from a work place setting, or on campus. One student completed the exam from another province! Students appreciated being able to define the atmosphere and set up their work space for the exam; for example, listening to music at home, spreading out books, resources and tools. Finally, students liked the open-book nature of the exam; some reported increased confidence because they could access their textbook and notes during the exam.

On the other hand, students disliked the idea of unsupervised exams and the potentially unethical conduct of their colleagues. The two main concerns with online exams were cheating and being able to access the instructor during the exam. Although we published contact information for the instructors (home and campus numbers), students were concerned that they would not have immediate access to the instructor during the exam for questions, such as explaining the wording of an item, providing missing information, clarifying ambiguous items, and so on. A good number of students were very concerned about the potential for cheating, or group writing of the exam. They described the many (ingenious!) ways in which students could cheat, which they believed would penalize the more ethical students. Individuals reported some concern with the differences between a web interface and paper-based exams: 1) cannot write or do calculations in the margins, 2) little sense of how long the exam was or how much they had completed, and 3) not sure how to set up the workspace for the exam. Others commented on the relative benefits of submitting answers using point-and-click radio buttons versus color-in-the-bubbles scantron sheets.

Instructors who wish to experiment with WebCT's online testing features are well advised to post the exam on a dedicated server (we used a dedicated NT server) in order to reduce potential access and network load problems. One student prepared to answer the test at home early in the evening (~6pm) only to discover that his Internet connection was down (i.e., Calgary-based internet service provider over which we had no control). The student had to drive to the University and complete the exam in a public area. A feature of WebCTs testing environment that concerned students was that the timer only updated posted "time remaining" when they submitted an answer. Ultimately, it is the student's responsibility to keep track of time. However, students felt the WebCT timer provided misleading information. Finally, all the questions were selected-response, with one best answer. Some students were disappointed there was no opportunity for partial marks.

Next Steps

We believe this experiment was a success, and will continue to refine our online testing and grading procedures. Moving forward, we believe it is crucial to use exemplary test construction procedures and principles for an online exam. For example, to alleviate student concerns about content and the exam structure, the instructor should provide a clear table of specifications that outlines the number of items and relative weighting of content areas, and provide practice items and opportunities prior to the graded online examination. In order to address student concerns about cheating, a supervised, online exam situation could be arranged whereby students complete the midterm during a scheduled time in a supervised lab. This would require booking sufficient computer workstations for the class, assigning students to a particular lab, and employing several laboratory assistants who could check student identity, monitor the exam, and answer student questions during the exam. However, a scheduled supervised exam would sacrifice the benefit of "anytime, anywhere" access.

Acknowledgments

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The Semiotics of the Web
A Semiotic Approach to the Design and Analysis of Web-documents

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Abstract: This paper seeks to discuss possible approaches through which semiotics can be applied to the World Wide Web seen as a multimedia; or, in other words, possible approaches through which Web-sites and Web-pages can be studied and designed from a semiotic point of view. The aim of the paper is thus to outline a coherent theoretical, methodological, and analytical framework for the study and design of Web-documents based on semiotics. The concepts dealt with include: signs, hyper-signs, codes, semiosis, icons, symbols, indexes, paradigms, syntagms, metaphor and metonymy.

> "Cyberspace is a universe of opportunities for semiosis to occur. Notice that we are no longer speaking about a specific medium like radio, television, news prints or telephone. Cyberspace is more like an environment or a complex system engineered for the act of signification to take place. It is not the real universe, it is a virtual universe made out of signs. It is a semioticians heaven … Semiotics will definitely be studying and drawing many conclusions from Cyberspace in the times to come. The work has already started and it should be encouraged to continue. It is for the good of the people that will inhabit this new environment to understand their relationship with the signs they get from it."
>
> Carlos Colon, 1995, Semiotics in Cyberspace

A Prolegomenon to the 'Semiotics of Cyberspace'

In the paper "Mapping the Web. A Media Typology for Information Traffic Patterns on the Internet Highway" (Jensen 1996) I delineated a basic typology for information traffic patterns and media types on the Internet. In "Interactivity – tracking a new concept" (Jensen 1997) I expanded this classification to a typology of interaction and interactivity in Web applications and other computer applications. In "Interaction and Representation in 3D-Virtual Worlds – From Flatland to Spaceland' (Jensen 1998) I outlined a conceptual framework for analyzing representation and interaction in virtual worlds based on sociology and semiotics, and in "Film Theory Meets 3D Internet" (Jensen 1999b) I suggested a film semiotic approach to the design and analysis of 3D Virtual Worlds on the Web. In the context of this paper, I want to proceed with this line of action and suggest a more general approach to the Web, drawing on resources from semiotics. In other words, the purpose here is to use semiotics to analyze the Web as a communication tool and media.

What will be suggested, therefore, in the present context is a semiotic discipline, capable of dealing with the semiotic functions and the cultural significance of the Web. This science should be called the 'Semiotics of the Web' and it should be seen as a specific semiotics – in Umberto Eco's sense – since it "is, or aims at being, the 'grammar' of a particular sign system, and proves to be successful insofar as it describes a given field of communicative phenomena as ruled by a system of signification" (Eco 1984). But it will at the same time be classified under a general semiotics, which it will both draw on and contribute to, just as it will constitute an important branch of the general humanistic approach to the study of the Web. In the present preliminary paper, however, this discipline can only be presented as a rough draft or in the form of 'a prolegomenon'.

The approach I have chosen, emphasizes the Web as an artifact, a cultural construct, an art form, or an aesthetic phenomenon, akin to phenomena such as literature, painting, music, sculpture, theater, architecture, dance etc. This approach presupposes that like all cultural constructs and aesthetic phenomena the Web as a medium and the individual Web-site and Web page may be understood as formal constructs. By stressing the Web as a cultural construct or as an aesthetic phenomenon, I necessarily ignore other aspects of the medium.

The Web of Signs

Why choose a semiotic approach to the Web or to Web-design?

In a way, the Web and the Internet can be considered as a more or less pure sign phenomenon. On the deepest level it is build on the 'universal language of computers', the binary notation or binary code, ones and zeros, which, however, allows the construction of very complex syntagms. On the next level it is constituted by communication protocols, that is, codes or rules – or more precisely, a encryption scheme or semiotic system – for the transmission of data over networks. And on the highest level it is constituted of signs appearing in the interface or the web browser: written words, graphics, images, animations, photos, videos etc. So in a way it is true to say that the Web fundamentally and in essence is build of signs. It is a world constituted exclusively by signs – a sign-world. Carlos Colon writes, e.g.: "Cyberspace is a universe of opportunities for semiosis to occur. Notice that we are no longer speaking about a specific medium like radio, television, news prints or telephone. Cyberspace is more like an environment or a complex system engineered for the act of signification to take place. It is not the real universe, it is a virtual universe made out of signs. It is a semioticians heaven. .... Semiotics will definitely be studying and drawing many conclusions from Cyberspace in the time to come. ... It is for the good of the people that will inhabit this new environment to understand their relationship with the signs they get from it" (Colon 1995). On a more general level, Jay David Bolter concurs: "What the computer promises is the embodiment of semiotic views of language and communication: that is, the views of Peirce, Saussure, Eco, and others. And this is hardly surprising, since semiotics itself is a product of the same intellectual forces that have produced the computer, including symbolic logic, linguistics, and philosophy. The computer is a machine for creating and manipulating signs; the signs may be mathematical, verbal, or pictorial. Computer programming and indeed all kinds of writing and reading by computer are exercises in applied semiotics" (Bolter 1991). And he continues: "The very process of semiosis, the movement from one sign to another in the act of reference, is embodied in the computer, and this embodiment is unique in the history of writing. In the computer, signs behave exactly as the students of semiotics expect them to behave. We could say that the theory of semiotics becomes obvious, almost trivially true, in the computer medium. ... Signs in the computer do precisely what students of semiotics have been claiming for their signs for more than a century" (Bolter 1991).

Moreover, from an etymological perspective, the concept of design – or de-sign – derives from the Latin 'signum', which means 'sign' or 'mark'. Design is, in other words, to set marks or form signs. So, design – including Web-design – is essentially to construct signs, a sign practice, a semiotic discipline.

For these and several other reasons, semiotics is a very appropriate and powerful tool in order to analyze and understand computer-based communication, and shed a new light on cyberspace or the Web.

The basic outline of a 'Semiotics of the Web' will be briefly sketched next, structured on the main components involved. The sketch will consist of an exposition of some of the available scientific literature on the individual areas, as the central concerns and conceptual apparatus of the science will be established.

Semiotics – Basic Definitions

Semiotics is the study of signs, codes, and culture. As a science it is concerned to establish the essential features of signs, and the way they work in social life, i.e., how meaning is socially produced from sign systems. Semiotics endeavors to reveal and analyze the extent to which meanings are produced out of the structural relations that exist within a sign system, and not from the external reality they seem so naturally to depict.

We must start, however, by defining such basic concepts as the 'sign'. Here, it may be useful to take as our starting-point the definitions employed in the American semiotic tradition, the semiotics of Charles Sanders Peirce.

According to Peirce (cf. Jensen 1993), every process of meaning has a basic, triadic structure, in the sense that the precondition for the creation of meaning – the sign – constitutes a relation between three semiotic entities. The Peircean definition of a sign is: "A sign, or representamen, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object." (Peirce, 1931-58: 2.228)

This definition can be briefly summarized as follows: The sign consists of: (i) the representamen, which is the physically manifest, perceivable sign – the entity that represents; (ii) the object, which is the item or phenomenon in 'external reality' that the representamen refers to – the entity that is represented; and (iii) the interpretant, which is the 'interpretation', 'code' or 'other sign' that deciphers and explains the representamen by linking it with the object; in other words, the element that establishes a relationship between the entity that represents and the one that is represented. Thus, the interpretant is the process by which the sign is defined, it is another sign or group of signs. Signs can only be defined in terms of other signs. The interpretant, therefore, may in turn be treated as a sign requiring definition. This process is in theory unlimited, because each new interpretant becomes a further representamen, thus producing another interpretant ad infinitum (cf. Fig. 3).

The actual sign is then finally constituted as a relationship between these three entities. It is this triadic relationship, this active, processual function between representamen, object and interpretant that Peirce calls semiosis. The triadic sign-model can be depicted graphically as in the following figure (Fig. 1):

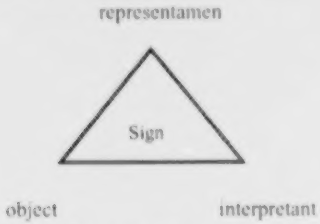

Figure 1: The triadic sign-model

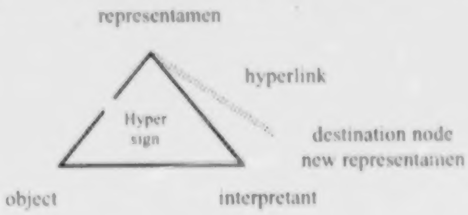

Figure 2: Model of the hyper-sign

In the case of a Web-page, the representamen is a given sign realized in the web browser – be it a word, a logo, a picture, or a graphic element – the object is that, which the sign refers to in the 'external reality' or 'real world', and the interpretant is the code in a mental apparatus that links these to entities by interpreting the first as 'standing for' the second. Likewise, in the Graphical User Interface or the WIMP-interface (based on Windows, Icons, Menus, and Pointers), common in many contemporary applications the graphical element is the representamen, which stands for objects, files or functions by way of an interpretant.

However, a representamen in a Web page may have one more relation that is not covered by the Peircean concepts – and which Peirce for obvious reasons couldn't see. Namely, the relation made evident by the concept of hypertext: A representamen may have a physical relation to another term in the form of a link from one node to another. This type of sign 'stands for' something in a new meaning of the word: it addresses not a 'somebody' or an 'object', but another term or node, in the sense that it is able to automatically trigger of that node or term. This other node or term may or may not be an interpretant of the first sign. Signs of this type we will call *hyper-signs*. Thus, on the Web (and, generally, in hypertexts) we have a unique sign-structure with a new type of *hyper-signs*. The hyper-sign can be represented graphically as in the figure above (Fig. 2).

According to Umberto Eco, the relations in the Peircian sign model between representamens and their interpretants (*unlimited semiosis*) (cf. Fig. 3) are forming a so-called 'global semantic network' (or in Umberto Eco's term 'the model Q'), following which it is possible to get from any given term to any other term in the network. In exactly the same way the relations between hyper-signs and their destination nodes are forming a global network or a web of inter-linked signs, following – or surfing – which it is possible to get from any given node to any other node in the global network. Whereas the first, however, is a semantic network of terms and cultural associations, the last is a web weaved of electronic, digital documents, connected via computer supported links that operate automatically at the reader's request and is carried via a physical network covering the entire globe, i.e., the Internet or, more precisely, the World Wide Web: "The act of "surfing" the Internet, following links can be compared to Peirce's concept of "unlimited semiosis" (as illustrated in Fig. 4).

Types of Signs

Leaving the hyper-sign aside, Peirce suggests that there are three main types of signs with respect to the relationship between representamen and object:

- *Icons*. An icon is a sign in which there is a marked physical or perceptual resemblance between the sign and the object for which it stands. Typical examples of icons in Web documents are representational drawings, photographs, videos, etc., or the use of – exactly – 'icons' in the browser's toolbar, such as the 'home' icon in Netscape Communicator.
- *Indexes*. An index is a sign that is connected to its object, either causally or existentially; it seems to be part of that to which it refers. Thus, indexes have a certain affinity to metonyms (cf. below). The term 'index' comes from the Latin 'indicare', indicate, related to 'index finger'. Thus, the act of pointing, used to call attention to some particular object is an index. In Web applications the cursor representing the users is the prototypical form of index signs, indicating the position of the user or what the user is pointing at.
- *Symbols*. A symbol is a sign in which there is no resemblance or causal relation between it and the object, i.e., a sign that stands for something other than itself by virtue of an agreement or convention among the

members of the culture that use the sign. Typical examples of symbols in Web documents are the use of written language, logos etc.

Thus, iconic signs are motivated, because of the 'natural' bond between representamen and object, whereas symbols is unmotivated or arbitrary, because the representamen is related to the object only by convention. Note however, that although some of the icons in the interface are icons in the Peircian sense, in that they are stylized representations of objects, they are not icons in the sense that the objects or functions they represent or activate are what the icon actually 'stands for' or resembles. Instead the sign can be said to be a metaphor (cf. below).

Thus, the WWW can bee seen as a web of icons, indexes and symbols, or as Philippe Codognet concludes: "As in all semiotic systems, ... the web is a mesh of icons, indexes and symbols".

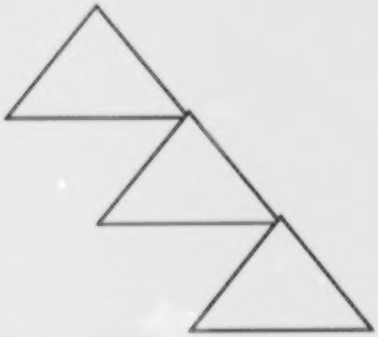

Figure 3: 'Unlimited semiosis'

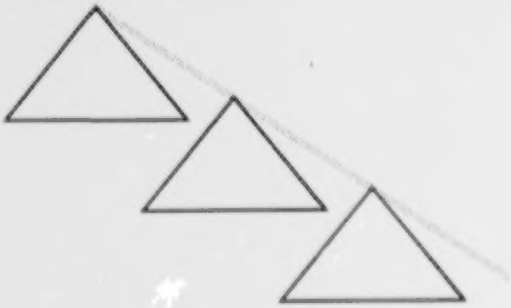

Figure 4: Surfing as 'unlimited semiosis', following hyperlinks (dotted line)

Codes

According to semiotics all communication and all production, distribution and decoding of meaning are based on signs. Consequently, signs, and the ways they are organized into codes or languages, are the basis of any study of communication. That goes for the Web as a communication phenomenon too.

Signs are always organized into codes. A code is a system of signs governed by rules agreed explicitly or implicitly between the members of the using culture. Thus, codes depend on specific knowledge obtained from inhabiting a specific culture. Codes have the following features

- Codes have a number of units arranged in paradigms from which one is chosen. In the context of the Web examples would be, the paradigm of possible fonts from which one is chosen in any given case, the paradigm of possible background colors from which one is chosen in any given case, the paradigm of possible markings of hyperlinks from which one is chosen in any given case, and so forth.
- The chosen units are combined syntagmatically into a message or text. A Web-site or a Web page is not simply a random collection of elements. As in all cultural constructs or artistic media a pattern exists, that is, an internal system governs the relations among parts. In the context of the Web, examples would be rules for the construction of correct sentences, i.e. syntax, grammar etc., rules for combinations or montage of text and images on the two dimensional plane etc.
- This gives the following relationship between the two concepts of syntagm and paradigm: A syntagm is a combination of elements chosen from paradigms to constitute a signifying whole. This combination can unfold in space (pictures), in time (speech) or in time-and-space (movies and the Web). A paradigm, on the other hand, is a set of elements from which one may be chosen to combine with elements from other paradigms to form a syntagm. A paradigm, then, is a set of elements that have an overall similarity. In a syntagm the meaning of an element is determined by how it interacts with the other elements, hence the same element can have different meanings in different combinations; whereas in a paradigm it is determined by how it is distinguished from the others. So, the paradigmatic dimension is that of choice, the syntagmatic that of combination. Like all other languages and codes, a given Web page can be conceptualized as a syntagm formed from units from a host of paradigms: backgrounds, layouts, fonts, icons, texts, pictures, video etc.

- Codes convey meaning that derives from the agreement among, and shared cultural experience of, their users. In the context of the Web examples would be conventional meaning applied to a 'home button', 'logo buttons', frames, banners etc.
- Codes are transmittable by their appropriate media of communication. In the context of the Web, the medium could be identified as 'The Internet', the physical connections or the physical network with the agreed upon protocols for transmitting data.

There are several different kinds of codes. Fiske, e.g., speaks of 'broadcast codes' versus 'narrowcast codes'. 'Broadcast codes' are shared by members of a mass audience and learned through experience, while 'narrowcast codes' are aimed at a limited audience and require active learning. The special thing about the Web right now, is that it is in the process of transition from a narrowcast code to a broadcast code, addressing a mass audience and drawing on codes from more familiar media. For example, many Web pages today are constructed in a manner close to the paradigm of traditional print media, e.g., illustrated magazines, combining short bursts of text, images and often advertising graphics: "Without this familiarity the Web would still be an elitist, narrowcast code, indecipherable to the masses. The codes employed assume a literate audience, accustomed to varied forms of printed media, and to the basic operation of technological devices". Perhaps this is one indication of the beginnings of the conventionalization of signs on the Web.

Metaphor & Metonymy

Metaphor is often defined as a way of conceiving of one thing in terms of another, as one thing described in terms of something else. Metaphors normally express the abstract and unfamiliar in terms of the concrete and familiar, thus producing meaning by transferring qualities from one domain to another through implied comparison. In this way the user or reader can assign meaning to the unknown and unfamiliar and make the incomprehensible comprehensible. Metaphors work paradigmatically – they insert the unknown into a new paradigm from which it derives part of its new meaning. Metaphors, then, require active, imaginative decoding: the reader/user has to find which characteristics can be meaningfully transposed. The metaphor's primary function is therefore to facilitate understanding, but it also extends communication by playing on connotations, which make the meaning of the text richer. As such, metaphor is often at the heart of user interface design.

The use of metaphor is widespread within computing as examples such as 'desktop', 'windows', 'wastebasket' indicate. Metaphors associated with the Internet and the Web are often of a spatial nature. Terms such as 'navigate', :'explore', 'surf' or 'the information superhighway' are based on the notion of transportation or travel in space. The design of Web documents also includes a choice of a master metaphor to guide the design. (Just to mention one obvious example, the Web author can use the library – bookshelves-book-page – as an analogy for representing documents.) Web design furthermore includes interaction metaphors, images and concepts used to convey function and meaning on the computer-screen etc. There is currently much interest in metaphors for their explanatory power.

Metonymy is the substitution of terms suggesting an actual relationship. The substitution can be of a causal, spatial or chronological nature. Examples are a part instead of the whole, cause instead of effect, instrument instead of agent, container instead of contents, an object instead of its destination, etc. Metonyms work syntagmatically; we construct the rest of the 'story' from the part that we have been given. They tend to work invisibly: whereas metaphors draw attention to themselves by their artificiality and by the imagination required to decode them, metonyms seem so natural that they are easily taken for granted, and we fail to realize that another metonym might give a very different picture of the same whole.

Thus, rhetorical figures such as metonymy and metaphor can be used to focus and hold a user's attention on the crucial aspect of the information. Roman Jakobson claims that metaphor and metonymy are the two fundamental modes of communicating meaning.

Relations between two sign systems – say text and image – can also utilize rhetorical figures. For example, visual and verbal metonymy, i.e., an object expressed verbally is visualized by a part representing the whole.

Relations Between Different Sign Systems

Relations between or integration of two sign systems – e.g., text and image, image and sound, graphics and images etc. – can utilize different semiotic techniques. Semiotics often distinguishes between two different relations.

- *Anchoring*. The concept of anchoring means that one sign designates the meaning of another sign, e.g., written words can designate the meaning of an image, or the image can designate the meaning of a word. In this way signs and codes interact to support the decoding of the text.
- *Relays*. The concept of relays means that two different signs from two different sign systems supplement each other, e.g., in a drawn cartoon the written dialogue is not directly representing what is indicated by the drawings, but add additional meaning to the message.

Due to constraints in the utilization of images, it is of crucial importance in Web design to maximize the relation of, for example, text to image. Images can provide a critical catalyst for understanding. In this way images can add new dimensions to the information content presented on a page.

Conclusions & Perspectives

This paper has analytical, theoretical, methodological, as well as practical implications. It is of interest in relation to the analytical and theoretical understanding of the new and rapidly growing Web medium, and in relation to methods of examining this phenomenon. The study shows that concepts and categories from the field of semiotics are highly relevant to the area of the Web and it indicates that the concepts presented here can form the building blocks for a more general 'Semiotics of Cyberspace'. The observations from this study may also have an effect on conventional theory formation and understanding within semiotics, communication research and media studies. However, it also has implications for the construction and design aspects since the design of Web-documents and Web-sites must be based on actual knowledge of the conditions and possibilities for communication and the construction of signs, codes and meaning in the new medium.

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WWW – Who? Where? Why?
A Media Sociological Analysis of Demographics, Consumer Trends, and Content Trends
with Special Reference to Entertainment & Entertainment Seekers on the Web

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Abstract: The aim of this paper is to describe the World Wide Web on the basis of current and future trends in demographics, consumer segments and content. The focus is on the currently fastest growing content type and user segment on the Web: entertainment and entertainment seekers. The paper addresses questions such as: How many people are online? Who are the users of the WWW? Where are they located geographically? How big is the Web in regard to hosts, sites, pages etc.? Questions of this nature can be given quantitative answers. However, the paper also speculates on the question of 'why': Why are people on the Web? What kind of content do they seek? And what are the typical activities of online entertainment seekers? These questions must in part be given qualitative answers.

How Many People are Online?

The science of assessing how many users are online the Internet throughout the world is an inexact one at best. There are a lot of estimations and surveys, using all sorts of measurement parameters and criteria. Based on some of the published surveys over the last couple of years, Nua Internet Surveys (2000a), however, make the following 'educated guess' as to how many are online worldwide as of March 2000. The number is 332,73 million. The vast majority of these users are located in the US and Canada – 147,48 million to be exact – followed by Europe (91,82 million) and Asia/Pacific (75,5 million). The following table (Tab. 1) indicates the breakdown of the numbers on different continents.

Location	*Users online*
World Total	**332,73 million**
Africa	2,77 million
Asia/Pacific	**75,5 million**
Europe	91,82 million
Middle East	**1,90 million**
Canada & USA	147,48 million
South America	**13,19 million**

Table 1: Estimation of users online the Internet (Source: Various: Methodology Compiled by Nua Internet Surveys)

In like manner, the estimations of how big the Web is, vary widely. The latest results from Network Wizards and the Internet Software Consortium show that the Internet currently (that is, as of January 2000) consists of 72.398.092 'advertised' connected computers or hosts. This corresponds with a current annual growth rate at 63%. Based on this average growth rate, the 100 million host level will be reached the last quarter of 2000, and 1 billion hosts will be reached in 2005 (cf. Next Generation Internet 2000). The following figure (Fig. 1) shows the number of hosts 'advertised' in the DNS from Jan. 1993 to Jan. 2000.

According to a report by OCLC Research (findings taken from the group's Web Characterization Project, which was conducted in June 1999), there are now 3.6 million sites on the Web, of which 2,2 million are publicly accessible, up from a total number of 800.000 available sites in 1997. Among the 3,6 million sites the largest 25,000 sites account for 50 percent of the total content available on the Web. The average Web site is made up of 129 pages, up from 114 pages in 1998 (cf. OCLC research). Despite the enormous number of sites, research from Netcraft (cf. Tchong 2000a) shows that 80% of all traffic ends up at only 0,5% of all URLs, corresponding to about 15.000.

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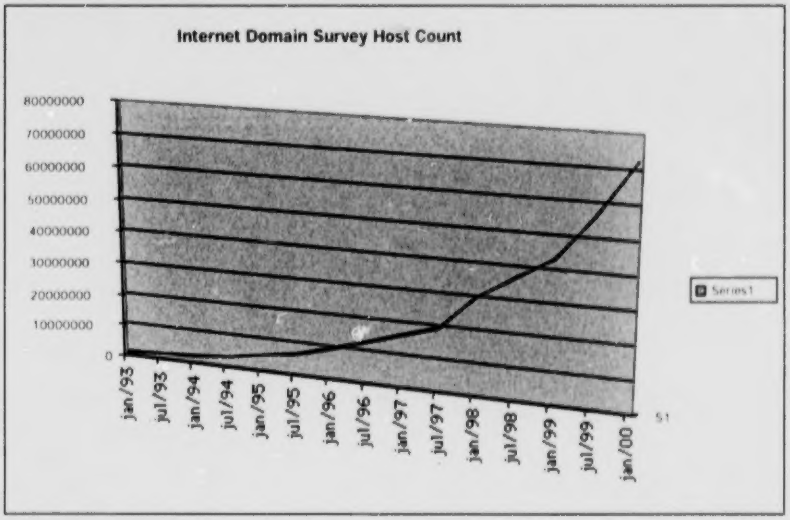

Figure 1: Number of Hosts advertised in the DNS (Source: Internet Software Consortium (http://www.isc.org/)

Compared to OCLC, the Danish-born Internet guru, Jakob Nielsen indicates considerable higher figures. According to Nielsen, as of 1999 there were 10 million sites on the Web. Nielsen expects that the Web will grow by a factor of 20 over the next five year, i.e., in 2005 there will be about 20 times more sites on the Web, corresponding to 200 million sites. As regards the number of pages it will increase even more, because already established sites will keep adding pages, even as new sites are launched. Thus, Nielsen expects the Web to grow from one billion pages in 1999 to 50 billion pages in 2005.

Concerning the number of users, Nielsen expects the growth to be less rapid, among other things, because many countries have problems with the infrastructure, making it difficult and slow to get the main part of the population online. While Nielsen estimates that there are about 200 million Web-users worldwide in the beginning of 2000 (a lower assessment than NUA), he expects that there will be about 500 million people online in 2005, and that this figure will grow to one billion around the year 2010 (Nielsen, 2000).

As more and more ordinary people go online, the users of the Web are changing and, consequently, the online population will to an increasing degree show affinity to the audience of traditional mass media such as television, radio and film. In the same process the content on the Web is undergoing dramatic changes.

Trends in Online Entertainment

In 1998, a revolution occurred on the Internet, practically without anyone noticing it. For the first time more users turned to the Web for entertainment content than for any other content type or services, such as business use, news, shopping, etc. A report by Cyber Dialogue from early 1999 found that more than 40 million – or more than two-thirds – of all *active* Internet users seek entertainment content online. Taken as a whole, online entertainment represents the single most popular content category on the Web. So, if it is true that 'Content is King', then, definitely, 'Entertainment is Content King' on the Web now. Entertainment, in this context, is defined as four key content categories, including sports, movies & TV, music, and online games. The figure below (Fig. 2) shows the recent growth from 1997 to 1998 in online users of entertainment content in each of the four content categories.

Jupiter Communications/NFO Interactive (cf. Tchong 2000b) has a more comprehensive, but in some respects comparable list of "what users do to entertain themselves online", published Dec. 1999 (Tab. 2). Here, the term 'percent' indicates percentage of users who say they go online for any of the mentioned activities at least once a month. And the term 'Worldwide Users' refers to estimated number of worldwide users based on IDC's yearend 1999 estimate of 196 million users.

Demand for online entertainment has grown even stronger recently. A report by Gemini Consulting and Honkworm International from the beginning of 2000, predicts that the online entertainment market will increase in value by 64% in the year 2000, reaching US$1,8 billion, going up from

US$1,1 billion at the end of 1999. The report also points out that net-specific entertainment content is the current growth area and that 'webisodes', Internet entertainment content excluding games, Net TV and adult entertainment, will be watched by more users for longer periods of time.

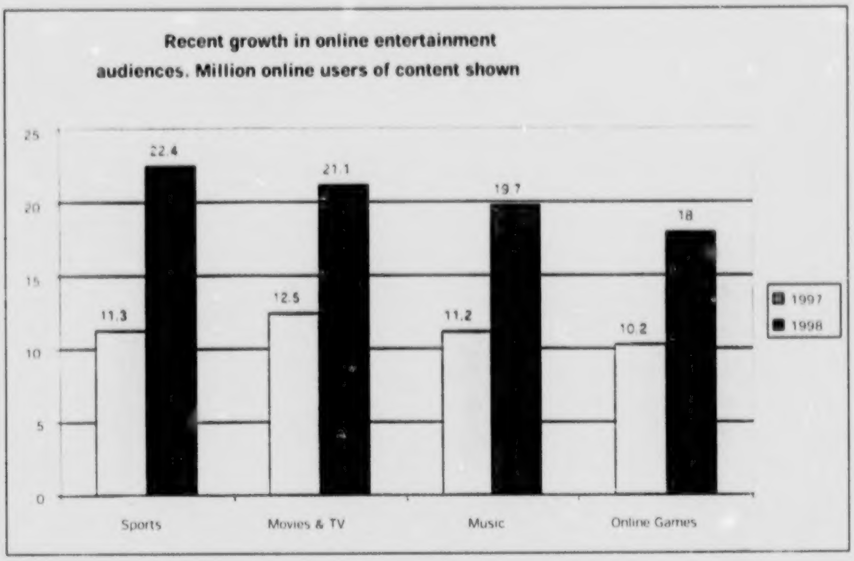

Figure 2: Recent growth in Online Entertainment Audiences. Million online users of content shown

Online Activity	*Percent*	*Worldwide Users*
E-mail	96%	188M
E-greetings	55%	108M
Instant message	51%	100M
Travel research	47%	92M
Online chat	45%	88M
Music sites	40%	78M
Play games	38%	74M
TV program sites	33%	65M
Sports sites	28%	55M
View video online	25%	49M
Download music	22%	43M
View adult content	22%	43M
Movie-related sites	18%	35M
Online dating services	7%	14M
Gamble	2%	4M

Table 2: What users do to entertain themselves online (Source: Dec. 1999 Jupiter Communications/NFO Interactive) (Tchong 2000b)

Returning to the report by Cyber Dialogue, the following table (Tab. 3) points out four segments of online entertainment seekers, again identified by the four key content categories, but in this case, measured in percent of total Net users in 1998 (Cyber Dialogue, 1999).

Sports fans, the largest segment, are the most affluent, according to Cyber Dialogue. Their most popular activities are checking scores, schedules, and reading game summaries. Movie and television fans typically search for information on actors, read industry news, interviews, and download clips. Music fans are the youngest segment, and 8 percent of them purchase music online. Contrary to conventional wisdom almost half of online gamers are female (47 percent). Action games, word games, and trivia games are the most popular types of games.

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Overall, entertainment seekers are more intensive Internet users compared to all online adults (Cyber Dialogue 1999). Moreover, online entertainment users seem to use all types of content. That is, sports fans also download music and movie content, and often play games, and vice versa, as substantiated in the next table (Tab. 4).

Entertainment Segment	*Percent of Net Users*	*Notes*
Sports	36%	Most affluent segment
Movies & TV	35%	Women at parity with men
Music	32%	45% aged 18-29
Online Gamers	29%	47% female

Table 3: The four entertainment segments in percent of Net users in 1998

Movie & TV Fans	**Music Aficionados**
Also visit	Also visit
• Music Sites 58 %	• Movie/TV sites 62 %
• Sports Sites 44 %	• Sports Sites 49 %
• Game Sites 30 %	• Game Sites 35 %
Sports Enthusiasts	**Online Gamers**
Also visit	Also visit
• Music Sites 50 %	• Music Sites 53 %
• Movie/TV Sites 48 %	• Movie/TV Sites 49 %
• Game Sites 32 %	• Sports Sites 48 %

Table 4: Mixed use of entertainment content (Source: Cyber Dialogue 1999)

A new survey by Cyber Dialogue from the beginning of 2000 (cf. Cyber Dialog 2000b) shows that demand for online entertainment has grown even stronger recently. In 1999 nearly 3 out of 4 *active* adult online users – approximately 50 out of 70 millions – retrieved entertainment, making online entertainment the single most popular content category on the Web again this year, surpassing news, product information, business information, and health/medical information. The next figure (Fig. 3) shows the online entertainment user segments in 1999. Measured in percent of all online adults, Music Aficionados – now the largest segment – make out 42%; Sports Enthusiasts 39%; Online Gamers 30%, Movie Fans 26%; TV Fanatics 23%; and Online Gambles 5% (notice that the categories have changed compared to the year 1998).

Among these user segments, music aficionados experienced the largest growth of all entertainment categories in number of users in 1999, reaching 29,2 million by the end of Q2 1999 (representing 42% of all online adults population), up from 19,7 million in 1998. Segmented by gender the data indicates that nearly half (47%) of all men on the Internet retrieve music content, compared to 37% of all women. Segmented by age, the most significant findings are that music content usage decline significantly with increasing age. More than half (57%) of the online adults age 18-29 fall into the music aficionados segment, among adults age 30-49 it is 41% and among adults age 50+ it is only 24%.

Concerning sports content, 39% of all online adults retrieve this content type. Not surprisingly, the vast majority of the sports users are men, 54%, compared to 24% women. Online sports users who are 18-29 year old are as likely (44%) as 30-49 year old (42%) to retrieve sports content. Among users age 50+, sports content is the top entertainment content category (28%). More than half (57%) of the sports segment say that they use the sports sites to 'check scores and standings', followed by usage patterns such as 'read sports news or game summaries' 28%, 'check game or events schedules' 24%, 'visit team or league sites' 8%, 'play sports trivia' 2%, 'play sports fantasy games' 1%, 'purchase sports merchandise' 1%, 'download video clips or games/replays' 1% (Fig. 4).

Turning to online users of game content, they make up 30% of the total population of online adults. There has been a 3,1 million increase in the game segment from year-end 1998 to Q3 1999. Especially in the second haft of 1998, this segment showed rapid growth with a 55% increase in number of users. Among the online game users 46% reported 10 or more visits to games sites in the past three months, 12% reported 5-9 visits and 36% reported under 5 visits during the past three months.

Among the users of movies/television the most common activity, by far, is to 'read movie reviews and summaries' (59%), followed by usage categories such as 'search for films by artist/movie title' (14%), 'read movie industry news' (11%), 'read interviews with stars' (8%), 'download movie clips' (6%), 'purchase movies' (1%) (cf. Fig. 5).

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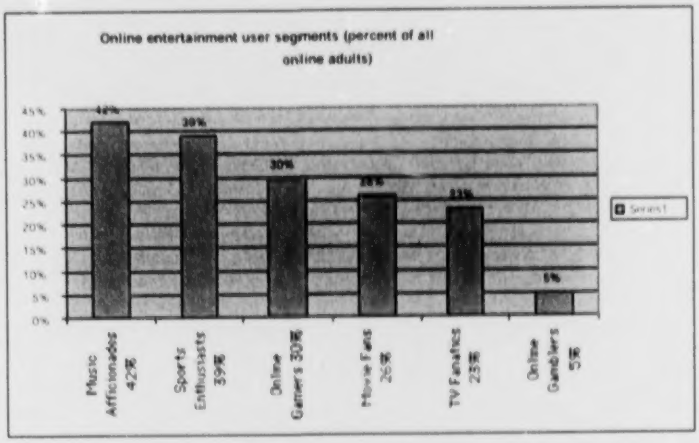

Figure 3: Online entertainment user segments in percent of all online adults in 1999 (Source: Cyber Dialogue 2000b)

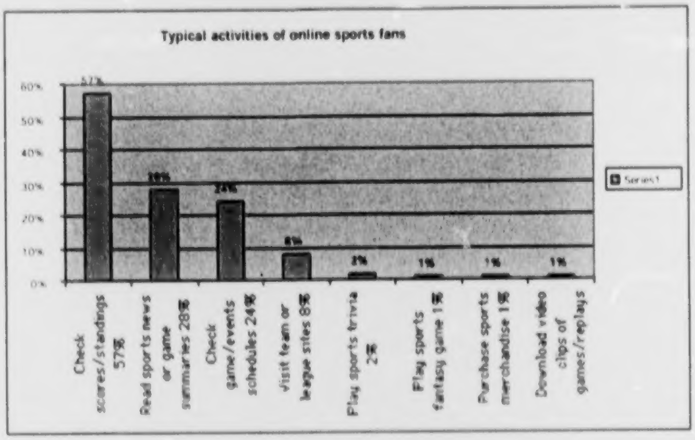

Figure 4: Typical activities of online sports fans (Source: Cyber Dialogue, 2000b)

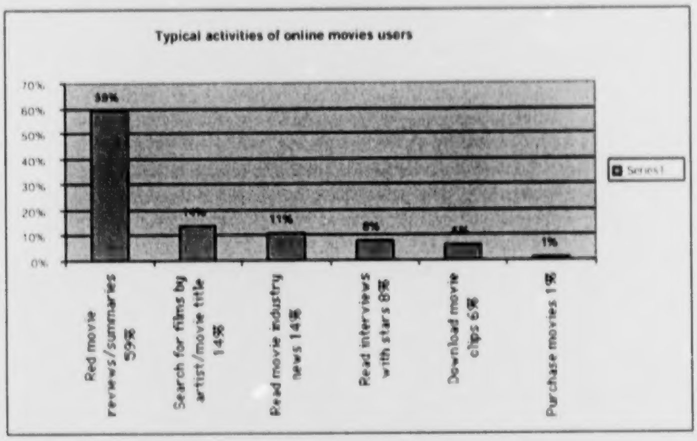

Figure 5: Typical activities of online movies users (Source: Cyber Dialogue, 2000b)

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The Future of Entertainment on the Web

A few remarks on the future of online entertainment: A report from USWeb/CKS, *Charting the Future of Online Entertainment*, which examines the right formula for entertaining online consumers and how businesses can build viable entertainment businesses online, identifies five principles that will shape the future of entertainment on the Web.

- The user's experience will become the product
- 'Creative' will leverage the Internet's interactivity
- Personalized digital delivery will replace mass distribution
- Commerce will become the primary revenue generator
- The major players will remain the major players.

These are some of the future trends in online entertainment on the Web.

Concluding Remarks

There are a series of conclusions to be drawn from the arguments presented in the above

- the number of users on the Internet and the size of the Web will experience a dramatic growth in the foreseeable future
- the users of the Web are changing as more and more ordinary people go online, consequently, the online population will to an increasing degree show affinity to the audience of traditional mass media such as television, radio and film
- in the same process – as a consequence as well as a cause – the content on the Web is undergoing dramatic changes
- entertainment content will prevail on the Web, in other words, from now on 'Entertainment is Content King' on the Web

Acknowledgment

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Trends in Interactive Content & Services on the Web

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Abstract: The aim of this paper is to introduce and discuss some of the main issues associated with 'interactive content and services', primarily in the context of networked multimedia, i.e., the Internet, World Wide Web, and intranets. The current trends in interactive content and services that will be dealt with in this context include: pull/push re-balancing, integration of Web and broadcast, 3D inhabited Web worlds, personalization & customization, participatory publishing and re-purposing of content or multiple terminal destinations.

An aura of magic and mysterious power seems to surround the concept of 'content'. Media publishers, software companies, telcos, and film and television industries are pursuing 'content' as the Holy Grail of the information age. Everyone wants to team up with the 'content owners', the copyright holders of the big media archives and libraries. And, at the many conferences, trade shows and seminars around the world dealing with new media technology, the saying "Content is King!" has already become a cliché.

Furthermore, if 'content' as a concept is endowed with magic, the concept of 'interactive content' is even more magical. 'Interactive media' are grabbing the headlines and there is no limit to the hype. 'Interactive content' has become the more or less authoritative and official gospel in the converging industries. 'Interactivity', so the story goes, will put the world at your fingertips; 'interactivity' will transform what used to be boring, passive experiences into something much more full, vivid and engaging; and 'interactivity' will give birth to a new epoch in commerce, entertainment, education, and forever change the ways you shop, play, and learn. Although the potential of 'interactivity' is widely recognized, and despite the fact that 'interactive content' has been subject to this kind of hype and media attention, it has received remarkably little attention within the research community. The concept of 'interactivity' remains poorly defined (cf. Jensen 1997, 1998a, 1999b and 1999c) and 'interactive content' as products and as a business is still not well understood. Thus, interactivity and interactive content are clearly areas in need of theoretical and analytical work.

The aim of this paper is to introduce and discuss some of the main issues associated with 'interactive content', primarily in the context of networked multimedia, i.e., the Internet, World Wide Web and intranets.

'Content' as a concept refers to the media material available to the consumer via the media system, i.e., information, entertainment, services etc. On the one hand, this consists of the audio-visual material that characterizes the interface or program, and on the other hand, the interaction design, i.e., the way this material is accessed, navigated, and used. In other words, 'content' is what the user of a media system actually accesses, uses, or consumes.

One of the most significant and unique features of new networked media compared to the old is their interactive character. 'Interactivity' in this context signifies the active participation of the user in directing the flow of content. Consequently, 'interactive content' designates content types that exchange information with the user, i.e., in addition to conventional media's output to the user this type of content allows various amounts and kinds of input from the user to the media system, which can significantly influence the form, order, length, or structure of the message – the content of the media text (cf. Jensen 1997, 1998a, 1999b and 1999c).

New communication technologies and media always make new types of communication – new content, new services – possible. So obviously, new interactive technologies and networked media will change the premises for *how content* can be made available and *for the kinds of content* that can be made available. The questions then arise: What differences will these new interactive technologies make in terms of content? How can interactivity enhance or change current information and entertainment services? And what, exactly, is novel, informative, and entertaining about interactivity and interactive content? The complex and many-sided processes of change that the networked media are currently involved in, thus, create a whirlwind of questions. In what follows, we shall outline only a handful of them. The trends that will be dealt with in this context include: pull/push re-balancing, integration of Web and broadcast, 3D inhabited Web worlds, personalization & customization, participatory publishing and re-purposing of content or multiple terminal destinations.

Pull/Push Re-balancing

The new networked media not only represent a shift in information traffic patterns from what Kumar (1996) calls 'the-information-source-comes-to-you'-model to 'you-go-to-the-information-source'-model, or from what Bordewijk and Kaam (1986) call transmission to consultation (cf. Jensen 1996a and 1996b); they also mean new combinations and the convergence of familiar patterns – including a counter-movement from consultation to transmission. In recent years, the new media have frequently been described in terms of the buzzwords: 'push media' and 'pull media'.

Kelly et al. (1997) describe 'push media', typical examples of which are radio, television, and film, as follows: "Content is pushed to you. ... Push media arrive automatically – on your desktop, in your email, via your pager. ... The distinguishing characteristic of the new push media is that it finds you, rather than you finding it. That means the content knows where you are and what you are seeing" (Kelly et al. 1997). These media correspond in many ways to the information traffic pattern, which Bordewijk and Kaam call *transmission* and Kumar calls 'the information source comes to you'. 'Pull media', on the other hand, get their name from "the invitational pull you make when you click on the Web" (Kelly et al. 1997). In other words, pull media are media that you (interactively) steer. In many respects, they correspond to what Bordewijk and Kaam call *consultative* media and Kumar terms 'you go to the information source'.

Up to now, most of the new media offered via 'the Net' (e.g. WWW) have had the character of 'networked pull media' but Kelly et al. predict that these, in time, will be supplanted by 'networked push media'. The Web, as we know it today, is fading away and will be replaced by new point-to-point media. Under the heading, "The radical future of media beyond the Web" they write: "... a new medium is arising, surging across the Web in the preferred, many-to-many way: anything flows from anyone to anyone – from anywhere to anywhere – anytime. In other words, a true network like the telephone system, rather than a radiating system like radio or TV. This new medium doesn't wait for clicks. ... It means information that cascades, not just through a PC, but across all forms of communication devices. ... And it means content that will not hesitate to find you – whether you've clicked on something recently or not. It means, in short, a more full-bodied experience that combines many of the traits of networks with those of broadcast" (Kelly et al. 1997). In other words, the new networked media may be moving from the consultation pattern toward some sort of transmission pattern as the dominant information traffic pattern.

But perhaps this definition, which more or less equates push to transmission and pull to consultation, respectively, is oversimplified. A more subtle and sophisticated attempt at a definition, which furthermore distinguishes *old fashioned push media* from *new networked push media*, can be found in Ethan Cerami's book *Delivering Push*. Here, the central definition reads as follows: "At its heart, push technology (or Webcasting, as it is frequently called) represents a new model for the delivery of information across the Internet and intranets. The current model of Internet delivery consists of users pointing and clicking on Web Pages. Users 'pull' information from remote computers to their desktops. With push, users simply subscribe to 'channels', and information is 'pushed' automatically to their desktops. The information is constantly updated and tailored to meet the user's individual interests and preferences" (Cerami 1998).

The term 'push' is therefore in a certain sense misleading. Particularly if it gives rise to the specific image of an active agent sending information to another passive agent, that is, if it activates the notion of broadcasting. Most push media on the Net do not actually broadcast or push information in the same way as broadcasting media like television. On the contrary, push media work on a 'request-reply' or 'client polling'-model in which the client is the more active part. The client simply checks the server for new information, following a pre-programmed scheme. If new information is available, the client automatically downloads the information and stores it on the user's hard drive. Thus, information is not pushed to the user, but downloaded automatically instead of manually.

In the context of the Internet, 'pull' can therefore be defined as "Any *manual* mechanism for getting information off the Web. Currently, this includes pointing and clicking on Web pages. Users click on a hypertext link and pull the associated HTML page, along with images and applets, from a remote computer to their desktop" (Cerami 1998). Whereas 'push', correspondingly, can be defined as "Any *automatic* mechanism for getting information off the Web. From the user's perspective, *push* simply means the new information is delivered or retrieved automatically from a remote computer to the user's computer. No manual intervention is required. New information is updated periodically on a preset schedule" (Cerami 1998). In this sense, 'push' can not be equated with transmission or 'the-information-source-comes-to-you'-model. 'Push' is in itself, from the start, a complex combination of consultation, registration, and transmission, or simply 'automated pull' – a hybrid of old fashioned push & pull.

The advantages of push are therefore, among other things, the automatic and constant updating of information, which for example ensures delivery of time-critical data, the possibility of customizing (cf. below) the information to the specific user's needs and preferences, and the elimination of inconvenient download time.

So far, in the context of traditional media, push is better developed than pull. On the other hand, in the context of the Web, pull is better developed than push. But that is changing fast, and conceivably, the trend is towards a combination – or a re-balancing – of push and pull; a new kind of hybrid media form, that allows you "to move seamlessly between media you steer (interactive) and media that steer you (passive)" (Kelly et al. 1997).

Integration of Web and Broadcast : Internet@TV – or TV@Internet?

Another discernible trend in the current media landscape is the mixture of TVs and computers, broadcasting and the World Wide Web, or more specifically, TV's universal market acceptance and the Web's anarchic multimedia content. The only questions are: will broadcasting absorb the Internet in the form of Internet@Broadcasting? or will the Internet absorb broadcasting in the form of Broadcasting@Internet? or will the convergence result in a totally new and unique communication phenomenon?

The Web, as well as being a technology, has become a huge collection of interlinked information and entertainment including tens of millions of Web sites. However, the content of the Web is not restricted to being delivered over the Internet; it can be selected and distributed in other ways as well. There have been many experiments with broadcasting Web pages to television sets. This can be a much faster way of accessing Web pages than over a telephone line to the Internet. Broadcasting popular Web pages is seen by digital television operators as a service that will attract customers. Although the experiments differ widely, the strategy is the same: to transfer the Web from the PC in the study to the TV in the family room. The argument goes like this: The Internet itself is the 'killer application', and you just have to bring it to the unwired majority where they already are – on the couch. The success of this service could bring the Web to many more people, but at the same time it could dramatically change the form of the Web as it is today. Clearly, one aspect of this development is the convergence of television and the computer, of Internet and broadcasting, of 'push' and 'pull' technologies, – and consequently the integration of the Web and TV.

Several important trends bring the Internet and broadcasting together at this moment: At first many broadcasters feared that the rapid growth of the Internet would draw audiences away from traditional broadcasting and lead to its eventual demise. This fear has now more or less been substituted by a vision that sees broadcasters and content providers as perhaps those best positioned to turn Internet growth to their advantage. The Web is no longer seen simply as a shop window where broadcasters must have a site in order to keep up with competitors. Instead, many believe that the emergence of packaging and 'channel' concepts on the Web means that broadcasters can now use the Internet as a valuable extra resource through which to reach new consumers of their products.

In other words, the trend is towards the marriage of Broadcast and the Web, Television and the Internet.

Three Dimensional Inhabited Virtual Worlds: Inhabited Web-Worlds

Three-dimensional Inhabited Virtual Worlds (3D-IVWs) are generally the creation of images on computer screens that graphically mimic a three dimensional world. They first appeared in computer games and stand-alone multimedia applications, but are increasingly appearing in network-based systems, e.g., the Internet, intranets, World Wide Web (cf. Damer 1998, Jensen 1998c, 1999a and 1999d). Considered as new media, they can be characterized by the following traits:

- 3D-IVWs are generated from software, drawn as interactive computer graphics in 3 space dimensions (plus a 4th dimension in time), i.e., they exist only in cyberspace: in the digital domain of the computers and the computer networks.
- 3D-IVWs are represented on a two dimensional screen, i.e., 3D graphics in this context are understood as a way of representing 3D data in 2D so that it can be viewed on a computer monitor or a TV screen.
- 3D-IVWs usually contain computer-generated representations of their users in the form of so-called 'avatars'. In other words, this software is inhabited – inhabited by its users, designers and developers.

- These avatars can be moved around as computer graphics on the 3D scene and the movement is controlled interactively by the user.
- Each avatar has a viewpoint that is fixed relative to that avatar. Consequently, as the user moves the avatar around, its viewpoint also moves. In short, the user can interactively control the viewpoint relative to the 3D space or scene.

3D Inhabited Virtual Worlds are currently enjoying rapid growth. The most important and dominant applications of these 3D worlds are entertainment, communication, transaction, information, and navigation (cf. Jensen 1998c, 1999a, 1999d), and the majority is accessible from the WWW. Thus, while the Internet and the Web has (cf. Jensen 1996a), until now, primarily been a set of sites that could be visited, a pile of two-dimensional documents that could be surfed, it is slowly turning into a three dimensional space with a virtual volume – thereby, for the first time, giving the term 'space' in 'cyberspace' a literal meaning – i.e., an entirely digital environment that can be lived in and populated and in which the users can move around, communicate, interact, and experience the immersion in a computer generated world.

In these Inhabited Virtual Worlds, it is possible to meet and have (mediated) social interactions and communication with other avatars, i.e., other users on the network in real time, or with autonomous agents. Via these simulated interactions, a new type of virtual social practice and virtual social structure or culture is being created. These new virtual spaces and societies have, like society in Real Life, their own rules, norms and codexes – as well as ways of breaking them. In other words, the Internet or the Web is changing from a dead and flat library, into a social and communicative space: a web of human relationships – a community.

At the same time, two other aspects of the Internet or the Web are likely to change as well, *the content* and *the users*. Most old mass media as well as most new multimedia applications are insatiable with regard to content. Given equally insatiable digital storage and broadband distribution systems, it has become difficult to produce enough content to fill media capacity. We are reminded of Bruce Springsteen's "57 channels (and nothin' on)". Content, like fossil fuel, is becoming a finite, even a scarce resource. Furthermore, what is missing in these media is other people.

Rather than creating a hungry 'content monster' one of the basic ideas behind 3D-IVWs is to build a common context in which people feel comfortable and in which they want to express their personality and create their appearance and identity. One of the unique features and advantages of 3D-IVWs is precisely that people create their own self-authored content and that the service is, in a way, self-supporting and self-sustaining. In fact, in a way it is true to say that *people are the content*. The behavior of people, their interactions and conversations constitute the center and the chief part of the content.

Just as Andy Warhol in the heyday of the television medium proclaimed that in the future everyone would have 'fifteen minutes of fame', the designers behind 3D-IVWs predict that "in the future everyone will have fifteen Megabytes of fame" (cf. Bradley et al. 1996). Users will create their own monuments of digital fame in cyberspace. Letting users build their own spaces and make their own rules for how to govern them is seen as a way of attracting people to return to the same location again and again, in this way creating and sustaining a loyal customer base and community in 3D space. Thus it is believed that 3D-IVWs and 'Shared Spaces' will "turn surfers into settlers" (cf. Bradley et al. 1996). Bradley et al. writes: "If we combine Shared Spaces with an emphasis on participant authoring we will get network settlers – people putting a permanent, persistent presence of themselves on the network. They will start to build, to put down roots and develop relationships in the network. The new Wild West is on the Internet and the indigenous surfers are being joined by settlers" (Bradley et al. 1996).

Thus, it is the appeal of social chat, personal participation, involvement and participatory authoring that are the real attractions. It is – as Pavel Curtis once put it – *the people that are the killer app*. And it is the participant's input combined with the common context of electronic communities – in the form of 3D-IVWs – that will produce network settlements. That is, one discernable trend in networked media is that we are moving into an age of networked settlers. And just like 'Shared Spaces' are turning surfers into settlers, they will turn the network into a place, – a place for people.

Personalization & Customization

Personalization and customization are ways of managing information. Both relate to the information traffic pattern Bordewijk & Kaam (1986) call *registration*, that is, they are both based on the media system's registration of the individual user's choice, behavior, or preferences. However, there is a significant difference, concerning *the location of* the agency of this registration.

Personalization is driven by the computer, which tries to serve up individualized information to the user based on some model of that user's need. This form is also called adaption or adaptive systems or interfaces, i.e., systems and interfaces that seem to intelligently adapt themselves to the user by noticing patterns of interaction or responding to user idiosyncrasies or desires according to expectations. An example is Amazon.com's book recommendations, which gives each customer individualized recommendations of books based on the books they buy, i.e., the system learns your preferences by recording/registering what you buy. Thus, personalization requires the system to have some sort of information about the user.

Customization is driven by the user, i.e., is under direct user control: the user explicitly selects from certain options and thereby tailors the information. An example is the setting up of a home page on an Internet portal service that presents the user with a variety of options, concerning topics of interest, news channel, etc.

Therefore, one discernible major trend is the increasing customization and personalization of interactive content.

Participatory Publishing

Whereas personalization and customization can be conceptualized as an extended possibility of getting a personal fingerprint on the content in the consultation pattern via various forms of registrational procedures, participatory publishing can be seen as an enhanced possibility of getting a personal mark on the content in the conversational mode, i.e., as a producer and sender of information. The vision behind participatory publishing is to involve users and readers as active parts in the creation of content. Participatory publishing comes in many forms and flavors, e.g., regarding the degree and depth of participation and co-authorship.

In the most restricted forms users just vote on themes concerning the future development of a story line or the like. In more developed forms the users have the possibility of adding dynamic annotation to already produced content, e.g., a Web page, an essay, a book etc. User reviews on amazon.com would be a case in point. In yet more advanced forms the users have the possibility of participating in a discussion, starting a new thread in an already existing discussion, or even create a new topic by posting a contribution to a discussion forum. Examples here would be Usenet and more serious chat groups. And in the most advanced form *participant authoring* makes it possible for users to partake in a collective, creative process, just as the receiver or user can easily convert the sender-receiver relationship by sending an essay to an electronic journal, in this way becoming an independent author.

One distinct trend is thus a proliferation of the conversational pattern or, in other words, a significant growth in user-created added data and user-created content.

Re-purposing of Content and Multiple Terminal Destinations

The concept of 'media convergence' is in many ways misleading. At least if it is interpreted as a coming together of terminals or technological devices. As regards terminals, the tendency is in fact in the opposite direction, towards diversity and divergence. Not so long ago there were only a limited number of dedicated terminals: TV, radio, telephone etc. Now we are confronted – or already equipped – with a whole range of new terminals: PCs (desktop, laptop etc.), TVs (with a range of different sizes and set top boxes), game machines, Network Computers, telephones, cellular phones, palmtops or PDAs, and so on.

Rather than a convergence of terminals or technologies the trend seems to be towards maximization of terminal functionality. For example, the TV set is no longer just a dumb receiver of transmitted content but more and more often equipped with a set top box which provides the TV set with Internet access, interactivity, two-way communication, on-demand services and content etc. The telephone is no longer just a device for point-to-point spoken communication, but also a multimedia terminal for fax, text-messages, on-line information etc. Rather than establishing one key terminal for reception, the trend seems to lead toward interconnectivity between terminals, e.g., download schedules and addresses from a desktop to a PDA. This type of cross-terminal interconnectivity provides users with more flexibility in terms of when, where and how information is received and used.

On the other hand, there also seems to be a trend toward the maximization of service applicability or the re-purposing of content. Given the range of different terminals and the cost of producing content, content-producers do not want to create content for a *specific* single dedicated service that is only suitable to one terminal. On the contrary, they want to maximize the number of applications and devices on which the content can be received, that is, think up ways to make the content applicable to many different end-points. A way of doing this is through re-purposing content. One example is WebTV, a company, which literally pulls Web pages through a server system to re-purpose it for presentation on a TV screen, in order to compensate for the lower resolution of TV screens compared to PC monitors, among other things. Other examples are CNN which re-purposes news and background material from the television to the net, or newspaper companies that re-purpose news from the newspaper to online-services on the Internet.

Conclusion

In many respects, content is the least developed, least explored aspect of the new media. New forms of expression, new products, formats, genres, and services will, of course, evolve. When the PC was first introduced, word processing and the spreadsheets were just about the only software applications envisaged. However, once the technology was in place, applications proliferated at a previously unimagined pace. The same will surely occur in the case of the Internet and the World Wide Web. Still, 'interactive content' and audience demand for this interactivity is still not well understood. Interactivity and interactive content are clearly areas in need of theoretical and analytical work. Among other new trends in interactive content and services that need to be investigated are: portals, so-called 'amazoning', intelligent agents, 'content without responsibility', just to mention a few.

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Project-driven Learning on the Internet using webStract

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Abstract: *webStract* is a distributed software tool that supports the construction and delivery of Internet based courseware. It allows content providers to make effective use of the vast knowledge source of the World Wide Web and to present the students with qualified material in a structured manner. It takes advantage of the interaction capabilities of the Internet, to enable synchronous and asynchronous communication among distributed teams. An elaborate security mechanism allows creating a fine-tuned environment for teams and individuals participating in team projects. This paper explores the ability of webStract to support creation and delivery of courses designed for Project-driven learning, a practical instance of the just-in time learning paradigm. It elaborates on the services offered to the four principal stakeholders - course developers, teams, individual students, and course facilitators. webStract is currently being used in experimental courses.

1. Introduction

webStract embodies a *project-driven training* paradigm that has evolved from the author's teaching practice of courses in practical Software Engineering. The delivery of the course material is tightly connected to the progress of real-life projects conducted in collaboration with industry. With the advent of the World Wide Web, the course evolved into a web-supported format and progressed into *web-Book* (see Joerg W.B. 1994-97), successively exploiting the fast increasing capabilities of HTML/JavaScript and web browsers - for a historical review see (Joerg W.B. 1997). With the arrival of Java, the Internet technology finally offered a cost-effective way to create a tool that could support our vision of *project-driven training* – a problem-based learning model paced by the successive needs of a project. The model relies on project-driven team activities and integrates in a unique manner synchronous and asynchronous interaction with personalized training on demand. Students are guided through the phases of a learning project, based on scenario and alternatives specified by the course instructor. Virtual rooms or views visualize the phases of such projects. The "doors" represent the phase prerequisites (entry conditions), alternative strategies (multiple exits) and deliverables (exit conditions). The task in each room consists of identifying, analyzing and resolving a set of problems typical of the phase it represents, and consistent with the path chosen to reach the phase.

Three different services, eliciting complementary learning and problem-solving styles and phases, assist the students in those tasks. a) Synchronous facilities support informal chatting and agent assisted meetings. b) Asynchronous facilities maintain threaded discussions in virtual conferences and announcement boards, and c) a *knowledge base* that can be queried for learning material most pertinent to the students current task (just-in-time learning). These services were developed in support of the classical three-phase problem-solving model that pervades all engineering tasks. The model is complemented with a V+V cycle (verification and validation) to determine whether the right problem has been solved correctly, and to decide on further action. Students would typically use the synchronous facilities for discussions during the *divergence* phase (problem understanding and *brain storming*); the asynchronous facility would be used during the *convergence* phase (formulation of solution strategies and collaborative problem-solving). The off-line facilities serve the students needs for deeper reflection, secluded learning and individual contribution to the problem solution (*transformation* phase). Upon completion of the problem-solving phase, students use the interaction facilities for group and detailed reviews of their solutions. All these facilities must be seamlessly integrated, available anytime anywhere and complemented with services that monitor brainstorm sessions, coordinate on-line meetings, record and classify discussion threads, alert to deadlines, advise students on technical or conceptual alternatives, and generate problem-specific learning material on-the-fly. Four different stakeholders populate the project-driven training domain. The content provider prepares the course material, in content and structure; the teams manage a project through online collaboration; the individual resolves the assigned tasks; and the facilitator guides the students, ensuring that the project is a learning experience. In the following sections we show how webStract supports these complementary roles. WebStract has been developed with this model in mind; it is written as a standalone distributed Java application.

2. Supporting the content provider's role

A content provider's tasks consist of seeking quality information on the Internet, selecting and qualifying it, organizing and combining it with own on-line lecture material, structuring it to suit the course scenarios, and complementing it with means for interaction. webStract supports each of these tasks as follows.

2.1. Seeking Quality information

The World Wide Web is a rich source of quality information that can be used as reference material in courses. It may be difficult to find however, for various reasons: ranking bias (see Internet 2000), limited coverage (see Internet 1999) and weak discrimination of search engines being the most notorious. Top ranking in search engines is becoming more a matter of money than of accuracy or quality, therefore good material may be buried deep in the search results. The increasing volume of the WWW has led major search engines to rely more and more on client side 'submissions' rather than active searching. Searches often return large quantities of unrelated results that are difficult to filter out. webStract addresses these problems in a way similar to *meta-crawlers*: it uses lists of "interesting websites" (e.g. bookmark files or result pages generated by search engines) or directory locations in local or remote web servers, and successively retrieves web pages, by following links contained in the web pages and by exploring the structure of the directories that contain the pages. The retrieved web pages are first submitted to an extraction process D (see Babowal D. and Joerg W.B. 1999) that identifies key terms/expressions of interest and rates their significance with respect to the retrieved document The results of this process, after being verified by the content provider, are committed to *knowledge records* in a knowledge base. Fig. 1 shows the parameters associated with the key terms, that are recorded in the knowledge base. Content providers can build as many databases as they need within a webStract node and can enrich them continuously through successive analysis cycles. It is important to note that webStract does not store retrieved web pages, but only *knowledge about* them. The knowledge acquired through the extraction process and the subsequent verification by the content provider form the basic material in the knowledge building process of webStract.

2.2. Selecting and qualifying Knowledge

A major difficulty for novices, who turn to the Internet for information gathering, is the assessment of the quality of the material found, and putting it into relation to other material. webStract is based on the premise that the course content provider is best qualified to select, assess and put the material in a perspective suitable for the course. To this effect, webStract offers two fundamental constructs – the context filter and the annotation. The *context filter* is a fuzzy expression of *contexts*, which themselves are fuzzy sets of key terms. It is based on the assumptions that a document written for a certain context (*standard document*), is likely to contain a selection of characteristic key terms, and that a real document (written for a specific *domain of discourse*) usually contains a blend of contexts. The fuzzy weights in the context sets quantify the probability for the corresponding term to appear in a standard document; the probability ranges that result from evaluating fuzzy logic expressions in the context filters, define acceptable ranges for the corresponding terms, to be present in real documents. webStract uses an absolute norm to calculate the distance of a given document to the multidimensional cube induced by the context filter. Content providers use this tool to find how well particular documents match a domain of discourse, and apply an arbitrary threshold to select documents of potential interest, without having to review each individual reference suggested by the search engines. Once potentially interesting documents are selected, the content provider reviews them and may annotate them, by attaching notes to the corresponding knowledge record. webStract provides for multiple critiques to attach their individual notes. At the time of retrieval of the associated web page, the students at the click of a button can visit all attached notes. Fig. 2 illustrates the top-level view of a knowledge record – this is the knowledge that webStract stores about each web page that is deemed of interest to the course.

2.3. Organizing the on-line material

Once the knowledge base(s) are in place, the content provider must organize the knowledge for presentation. webStract offers two main tools for this task – *context filters* and *books*. They address two fundamentally different teaching approaches.

Context filters (as explained earlier), support an exploratory learning style: they provide a dynamic, weighted view into the database(s), i.e. the filter results may vary as the associated database is updated. Context filters can be applied iteratively, to refine the selection of knowledge records. The resulting selections can be reviewed for their annotations (and key terms), and the referenced web pages can be viewed in either a native browser or any browser of the user's choice.

Books support a well structured presentation style, by organizing selected document references into tables of contents and facets, and by providing navigation means to effectively ride the book structure. In contrast with the context filters, books present a static view that is 'frozen' at the time of the book's creation. webStract books can be organized into *facets*, which provide dedicated selections and sequences through the book's contents, to accommodate various reader's needs (e.g. beginners, experts, or particular interests). In practice, books are only structured collections of references (represented as individual tables of content for each facet): they do not store the pages, but only references to the corresponding knowledge records in webStract data bases. This adds the benefit of direct access to the knowledge compiled into the database by the webStract extraction process (weighted key terms) and by the Content provider's qualification (e.g. annotations), as can be seen in Fig. 3. It shows the facet selection at the top, the table of contents in the left hand panel, the display of the selected page in the right hand panel (using the *native viewer*), and the Annotation and Information buttons. Note that the web page can be displayed also in any browser of the user's choice. Navigation: the table of content consists of a collapsible tree, and provides random access to the book's content. Above the table of contents panel, the book viewer displays a *dockable navigation bar* for structural navigation, as pioneered in web-Book (see Joerg W.B. 1997). The buttons allow to step forward / backward through the structural entities of the book: chapters, subchapters or individual documents. Both the random access mechanism and the navigation bar are operational for the native viewer as well as for any external viewer.

2.4. Structuring tools

Books, context filters and databases are specific representatives of a generic structuring tool called the webStract *object*. webStract objects are represented by icons – accessing them opens a corresponding window. webStract objects can be complemented with a set of key terms to warrant their retrieval when searched for. This formalism leads to an extension of the notion of books.

As explained in the previous section, the need for books and context filters emerged from different learning styles associated with the various phases of the problem solving process. The initial focus of these tools has targeted electronic documents and the knowledge about them. webStract extends this notion by allowing the content provider to create knowledge environments – structured (nested) viewing areas for particular interests, that can be populated with webStract objects other than just databases, books or context filters, and that can be visually adorned to convey specific messages or guidance. These objects, just as books and databases are searchable, and can in turn become part of a book's content. *Views* are recursive objects that allow for hierarchical grouping of webStract objects. Views at the top level of a webStract node are called *work spaces* and are identified by tabs. All views can be adorned with backgrounds, graphical shapes, text and pictures. Individual Internet documents can be referenced with the *WWWLink* object; the *Knowledge Record* object allows putting the k-record for selected documents into a view; and the *Text* object allows affixing particular comments to views.

2.5. Supporting interaction

For two-way communication, any number of objects such as *Chat* (synchronous), *Conference* and *BulletinBoard* (asynchronous) can be instantiated in any view. *Chat* operates like many known chat rooms; it is intended as an informal tool with limited logging and no archiving, whereas *Conference* logs all activity. Its transcripts can be submitted to the extraction process at the time of archiving, so that subsequently, individual contributions can be retrieved through webStract's built in filtering and searching mechanisms. *BulletinBoard* is a simple two-way asynchronous announcement service, without threading, nor archiving. webStract boasts also a number of objects for one-way communication, such as *AnnouncementBoard*, *SuggestionBox*, *Banner* and *GuestBook* the names of which are self-explanatory.

3. Supporting the role of the team

Managing a team involves activities such as organizing and executing meetings, allocating tasks, structuring access to resources and facilitating proper levels of interaction. To this effect, webStract provides intelligent meeting agents, to-do lists and an elaborate security mechanism with shared spaces to control access.

3.1. Intelligent agents to support meetings

The meeting object in webStract acts as an agent that guides a meeting from its agenda to the archiving of its minutes. In its initial setup dialog it enforces good practices such as defining the type of meeting, setting its time frame, notifying all participants and selecting a meeting secretary. Opening the meeting icon before the meeting time, shows the agenda; opening the meeting icon during the set time frame, shows a dialog area with typical input and logging area, and with a set of control buttons dependent on the role of each participant. The meeting leader's buttons include a 'Vote' option and a "Synergy" option. The former instructs the agent to poll the participants for specific issues, to tally up the votes within selectable time and to broadcast the results. The latter instructs the agent to conclude the meeting: it invites all participants to review the meeting log and rate the relevance of each contribution; when the allocated time is elapsed, the agent collects the ratings, evaluates them and suggests a draft for the minutes to the secretary. Once the minutes are completed by the human operator, they can be submitted for extraction and for archival; the meeting icon then becomes a handle to the archived minutes. A "Participants" button allows any participant to query the list of logged in users.

3.2. Keeping the team in synch with To-Do lists

The *To-do* object can be instantiated in any view, allowing project members in various charges, to maintain a list of things to do, specific to their responsibilities. To enter tasks, the list owner must provide a task description and a due date. Tasks can also be associated with any existing object in the node. Opening a to-do object lists the tasks with a color-code to visualize their urgency (Fig. 4) and a reference icon that links the user directly to the object of concern.

3.3. Controlling access - Security and shared spaces

In a course setting, webStract is set up as a server node installed on a machine with a permanent IP address. This node is developed, maintained and operated by the course instructor, as the owner of the node. Students connect to the course node by running a client version (see next section) on their personal machine. Users accessing the course node can be allocated one of three access rights – builder, sharer or visitor (default), giving the privilege to add / remove webStract objects, to participate in activities, or to simply observe activities, respectively. Access rights can be defined for every individual object; by default they propagate downwards along hierarchies. The node owner may specify for each object individual access policies, which determine the access rules for each right – from 'unconditional' to 'password protected' to 'under no circumstance'. Protected access rules imply that users have to request a subscription; the actual access is then subject to the node owner granting the request once, and use of the password for every subsequent access. This mechanism allows the course instructor to build hierarchical 'rooms' that are accessible only to selected participants – class foyer for all, team rooms for respective team members, coordination room for teaching assistants, etc… By allocating particular privileges to the accessing participants, the instructor can define spaces where team members can share webStract objects such as private chat rooms, bulletin boards, web-books and links to shared documents.

4. Supporting the individual student

The client version of webStract offers students most services (objects) of the server version, with the exception of objects that need a server to fulfill their basic operation (e.g. chat, conference, guest book). Furthermore, given that most client nodes do not have a static IP address, they cannot be exported for remote access. Using the client version of webStract, students can create their own learning environment, catering to various courses, e.g. by creating different workspaces (distinguished by tabbed panes – Fig. 5). Students may build their own knowledge base, using the database, context, and book objects; they can structure their knowledge node by building view hierarchies and embedding aliases from remote objects. *Aliases* are a powerful referencing tool that allows users to place into their own space a copy of an icon that links directly to the original object located in any remote node. Students may build their own time management service by instantiating to-do objects and connecting them to the alarm facility. They can migrate also their node(s) to other machines (any other platform that supports Java and Swing – versions 1.1.8 and 1.1.1 respectively at present), simply by moving the node directory to the target machine.

5. Supporting the facilitator

The *project-driven training* paradigm encourages instructors to play the role of facilitators. The principal characteristics of such a role are the ability to guide students with well-adjusted steps, to observe their path, and to assist them finding their way out of or around difficulties. The built-in security and logging mechanisms of webStract support these characteristics. Besides determining which objects are accessible to whom and with what privilege, the security mechanism also features a means to declare objects remotely accessible or not, dynamically. Objects (including workspaces) with remote access disabled, are not visible to users with visitor and sharer rights. This gives the facilitator a tool to control the clutter on the screen by leaving visible exactly what is required for the current task. We have also built in two logging mechanisms. The *security logging* mechanism that can be turned on or off on a per node basis, records entry and exit for every webStract object, with timestamp, names and access rights. The *event logging* mechanism records events selectable by the node owner on a per object basis. The event logs are retained in chronological time-split files. By analyzing these files, the facilitator can determine the paths taken by the students, the time spent in each object, the number of objects simultaneously open, the participation in interactions and their relative progress. With this information, a facilitator is in the best possible position to assist and guide students effectively, independent of their physical location.

6. Conclusion

The WWW is being used more and more for on-line course delivery (Kessler G.C. et al. 1999), from simple posting of class notes to elaborate virtual Universities. Accordingly, a number of course construction and delivery tools have been developed, from toolboxes that transform existing courseware or authoring new material into *webBooks* (Hall T.L. 1997), to flexible environments supporting the traditional *tell and test* approach (Goldberg M.W. et al. 1996). With webStract, we have chosen a path that combines the Internet as a knowledge resource with a just-in time learning approach into a *project-driven training* paradigm. It emphasizes the growing significance of the Internet as a vast knowledge source, recognizing at the same time a growing need for qualification of information. The success of web services such as about.com, or the efforts of Apple Corp. to establish their iReview service are clear evidence of that latter need. webStract has been developed as a tool supporting the project-driven approach to learning, from the acquisition of raw material, elucidation, structuring, and integration of interaction facilities, to the delivery and coaching of students. It is built as a distributed application, integrating all its services into one consistent framework, and featuring both a server and a client version. Since it implements its own (RMI-based) communication network, in tandem with an elaborate security mechanism, it is also less vulnerable to security attacks.

webStract is presently in its beta stage and is being used in experimental course deliveries. From early feedback, we feel comfortable that it is well suited to any course that can be delivered in a project format, and it is especially powerful for delivery to distributed participants, teaming up as virtual teams. We have learned also that it is essential to inform students about the information that is being collected during the course, how it is being used, and give them an option to opt out. Experimentation has also shown shortcomings, some of which (performance, scalability) are a consequence of conscious decisions favoring proof of concept; others, such as the high learning curve to take full advantage of contexts and context filters, will need a careful review of both the user interface and the bootstrap process for knowledge building. Our choice of using serialization for node storage has made node construction during development, more vulnerable to successive versions as anticipated: changing base classes often made existing nodes incompatible across versions. Our plans for future work include extending the scope of the extraction process to other document types such as pdf and XML. We are exploring also a restricted client version as an applet for use with a web browser. We plan to incorporate scripting facilities to control the visibility and accessibility of webStract objects programmatically and thus introduce a higher level of individual and automatic guidance of students. This is a long term goal that we had outlined in an early extended abstract (Internet 1997).

Acknowledgements

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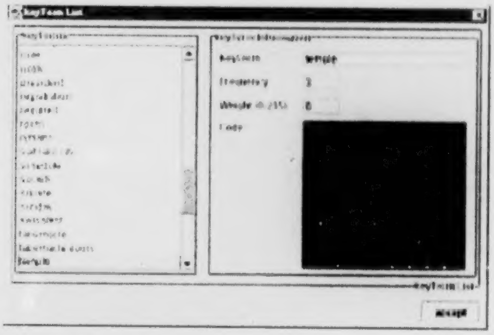
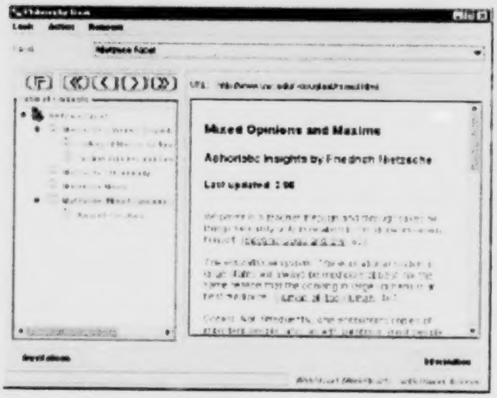
Illustrations



Keyword
Frequency
Weight
accept

Fig. 1 - Key term statistics



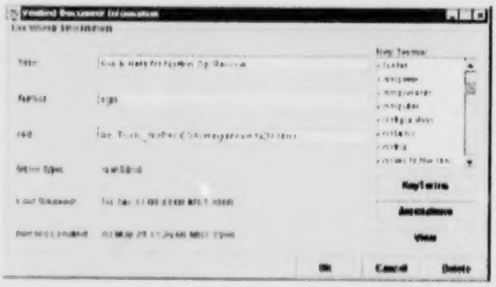
Look
Action
Relations

Mixed Opinions and Maxims

Aphoristic Insights by Friedrich Nietzsche

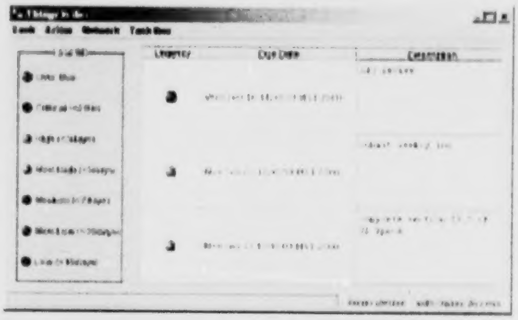
Last updated: 2/96

Fig. 3 webStract Book viewer



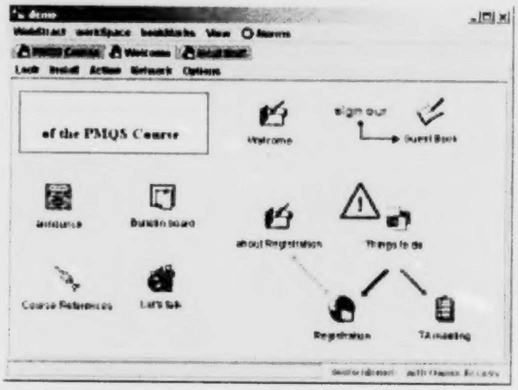
Key Terms
KeyTerms
OK
Cancel
Delete

Fig. 2 Knowledge record



Look
Action
Network
TaskBox
Due Date
Description

Fig.4 To-do list



demo
WebStract
workSpace
bookMarks
View
Alarms
Welcome
Look
Install
Action
Network
Options
of the PMQS Course
Welcome
sign out
Guest Book
announce
Bulletin board
about Registration
Things to do
Course References
Let's talk
Registration
TA meeting

Fig. 5 Workspaces of a webStract node

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Architecture for an Intelligent 3-D Practice Environment

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Abstract: This presentation describes an architecture developed for intelligent practice environments. An intelligent practice environment offers learning by doing enhanced with dynamic advice and feedback from a Knowledge-Based-System (KBS). An architecture implementation is described for intelligent 3-dimensional (3-D) practice environments developed using the Virtual Reality Modeling Language (VRML), JAVA, and an expert system. A VRML enabled web browser provides an interactive 3-D world where the user can learn by discovery and by doing. Integrating an expert system with a practice environment provides dynamic advice and feedback so the user can analyze his actions in the 3-D VRML world. The 3-D architecture implementation is described using components developed for mechanical skills training.

Background

This paper presents an architecture developed to study the capabilities of intelligent practice environments. Our past research produced structured practice environments that provided a training and problem-solving environment by integrating 3-D animations with multimedia Computer Based Training (CBT) techniques. Later, we extended these problem-solving environments into 3-D virtual worlds where the user could freely explore and learn by discovery. This paper describes an architecture that combines the learning opportunities of practice environments with the intelligence of a Knowledge-Based-System (KBS). Our first implementation of the intelligent practice environment architecture involved integrating a practice environment with an expert system. This was an ideal first step toward creating an intelligent practice environment because expert systems are widely used, the advantages are well understood, expert system engines are readily available, and programming an expert system is less complex than other Artificial Intelligence (AI) approaches.

Objectives

Our long-term objective is to develop realistic practice environments where a user can learn by discovery and gain mission qualifying experience by doing meaningful tasks. The objective of our current research is to continue to improve skills training by adding intelligence to realistic practice environments. Adding intelligence should improve learning by giving the practice environment the capability to adapt coaching and feedback to the user's individual needs and actions.

Cost is always an issue and affordability is a major objective. Finding ways to make practice environments an affordable training solution is a critical success factor for adoption of the technology. There are two major cost considerations for web technology, first we must be able to afford to develop the content and second we must be able to afford to deploy the content to the users. One way of reducing development cost is to develop modular components that can be reused. There is a high reuse potential for the architecture implementation illustrated in this paper. The expert system JAVA applet and VRML interface applet are reusable. The rule base for processing procedural steps and goals is reusable. The fact structure is reusable. The specific facts for the procedures and the VRML worlds are content specific and would have to be custom crafted for each lesson.

Practice Environments

Experience through practice is extremely important to the development of advanced skills. To develop advanced skills, the user needs to practice solving a wide range of problems and handling different situations. A highly interactive practice environment encourages the user to explore complex relationships and increases the development of advanced skills through self-motivated discovery and problem solving activities. Some of the capabilities that are essential for an effective 3-D practice environment are given in Table 1.

Practice Environment Capabilities	Learning Challenges	Practice Environment Solutions
Objective or Goal	A 3-D world can be overwhelming for an interactive user.	Give the user objectives and well-defined goals for his interactions with the 3-D world.
Learning Approach	Users can be overloaded with too many choices in a 3-D world.	Supply the user with a learning approach and a set of interactions appropriate for learning with the 3-D world.
Time Limit Expectations	3-D worlds can be fun with a lot of time spent exploring and not achieving the expected outcomes.	Provide timing guidance for goals and working with specific components. Allow sufficient time to discover important areas of the world and not miss a valuable learning experience.
Association	The user needs to be able to associate the world of 3-D objects and his interactions with related information and resources.	Associate related information with the practice activities performed by the user in the 3-D world. Resources available to the user in the real world should be available in the virtual one.
Coaching	Coaching and guidance enhance a user's learning experience while performing complex tasks.	Provide coaching and guidance based on the user's specific interactions in the 3-D world. Coaching increases motivation by preventing frustrating situations in the freedom of a 3-D world.
Feedback and Assessment	The user needs feedback and assessment to understand his progress.	Offer timely feedback directly related to the user's interactions to increase his ability to analyze the current practice situation.

Table 1: Effective 3-D Practice Environment Capabilities

Intelligent Practice Environments

Practice environments support learning by discovery and provide the basic capabilities for learning by doing. Adding intelligence by integrating with a Knowledge-Based-System can provide the dynamic assessment, coaching, and feedback capabilities that are essential for a positive learning experience. Figure 1 shows the basic intelligent practice environment architecture and Table 2 describes the interfaces.

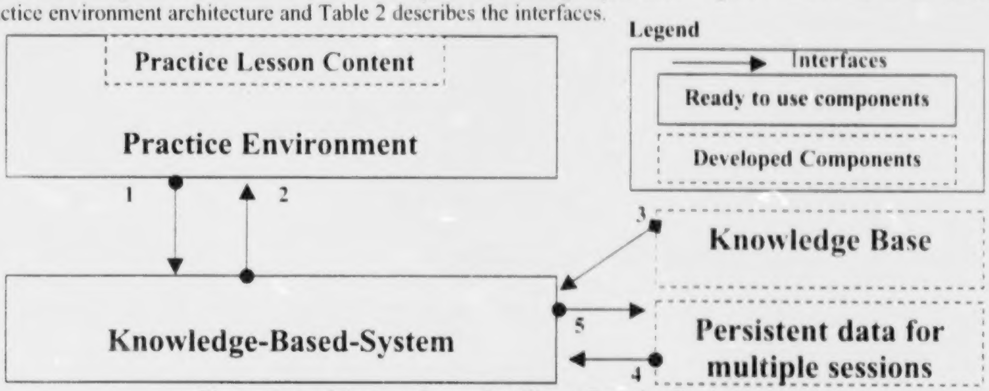


Figure 1: Architecture for an Intelligent Practice Environment

Expert System Example

Jess (Copyright 1998 E. J. Friedman-Hill and the Sandia Corporation) [Friedman-Hill 1998] is an expert system shell written in JAVA. The source code for Jess is available for integration with a practice environment. Jess is also distributed with sample applets and console applications. For the 3-D example, we used the VRML External Authoring Interface (EAI) to integrate the Jess expert system with VRML practice environments. We modified the Jess expert system interface to include buttons for feedback and advice. A simple knowledge base manages the sequence of practice activities, feedback, and advice for the practice environment. A set of facts define the practice activities, the sequence of activities, advice for each activity the user can accomplish at the current time, and feedback when an activity is successfully accomplished. The Knowledge Base contains a set of rules that manage the user's practice activities by determining which activities are valid at the current point in time and updating the VRML world based on the current situation. Figure 2 shows the configuration of existing products and developed software integrated to create an intelligent 3-D practice environment. Table 3 provides information about each of the interfaces in the implementation.

Interface Number	Interface Origin	Interface Destination	Purpose of Interface
1	Practice Environment	Knowledge-Based-System	Access information about user interactions in the practice environment.
2	Knowledge-Based-System	Practice Environment	Update the practice environment with coaching, feedback, state data, and user interaction information
3	Knowledge Base	Knowledge-Based-System	Load basic knowledge about the session into Knowledge-Based-System.
4	Persistent Data for Multiple Sessions	Knowledge-Based-System	Load knowledge and other state data stored from last session.
5	Knowledge-Based-System	Persistent Data for Multiple Sessions	Store knowledge and state information to be available in another session.

Table 2: Interfaces in the Intelligent Practice Environment

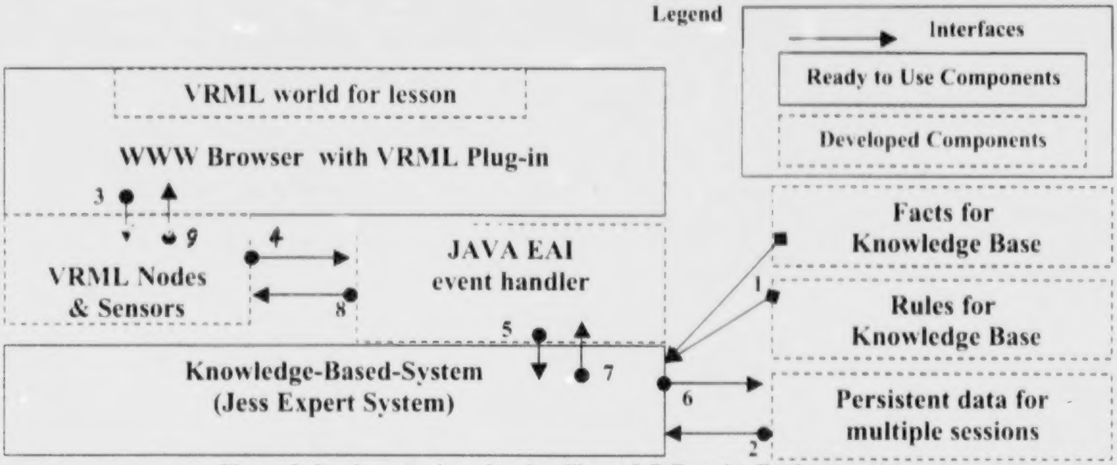

Legend
Interfaces
Ready to Use Components
Developed Components
VRML world for lesson
WWW Browser with VRML Plug-in
3
9
4
VRML Nodes & Sensors
JAVA EAI event handler
8
Facts for Knowledge Base
1
Rules for Knowledge Base
5
7
Knowledge-Based-System (Jess Expert System)
6
Persistent data for multiple sessions
2

Figure 2: Implementation of an Intelligent 3-D Practice Environment

Interface Number	Interface Origin	Interface Destination	Purpose of Interface
1	Rule Base/Fact Base	Expert System	Load rules and initial facts into expert system.
2	Persistent Data Store	Expert System	Load facts and other state data stored from last session
3	VRML user interactions	VRML Nodes & Sensors	Access user interaction data in the practice environment
4	VRML Nodes & Sensors	JAVA EAI event handler	Pass user interaction information and other state information to the JAVA EAI event handler for analysis
5	JAVA EAI event handler	Expert System	Update knowledge base; assert new facts based on user interactions and state of objects in the practice environment
6	Expert System	Persistent data store	Store facts and state information for another session.
7	Expert System	JAVA EAI event handler	Update practice environment state data, feedback, advice
8	JAVA EAI event handler	VRML Nodes & Sensors	Pass updated data from the expert system and JAVA EAI event handler to the practice environment
9	VRML Nodes & Sensors	VRML Scene	Update scene with expert system and JAVA EAI event data.

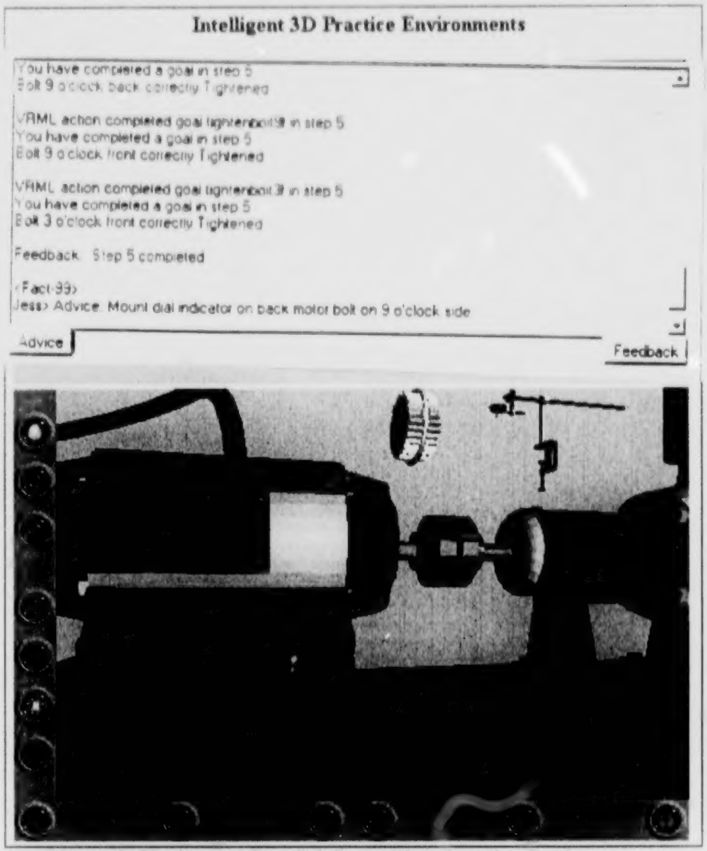
Table 3: Interfaces in the Intelligent 3-D Practice Environment

Mechanical Skills Example

The example used to illustrate our 3-D practice environment concepts was developed to teach maintenance technicians how perform shaft alignment tasks. Figure 3 shows a horizontal parallel misalignment correction practice environment.

The expert system advice and feedback is displayed at the top of the screen. The user receives feedback from his VRML actions in the expert system display. The expert system determines which activities the user can perform at the current time in the 3-D VRML scene. State information from the expert system is used to activate animations and selections in the VRML scene. The expert system display has two buttons that give the user access to advice and feedback at any time. The user requests advice with the advice button. The user automatically receives feedback when he accomplishes one of the active tasks. The effectiveness of the advice and feedback is dependent on the quality of the knowledge captured in the knowledge base.

This practice session illustrates problem solving for a set of sequential activities that the user will accomplish in the 3-D practice environment. The initial fact data is loaded into the knowledge base when the practice environment is started and the facts are updated as the user works in the practice environment. The rules in the rule base interact with the 3-D practice environment to activate objects that the user must work with to accomplish goals in the procedure. These objects include the dial indicator, the reset or zero knob on the dial indicator, the motor, and the motor mounting bolts.



Intelligent 3D Practice Environments

```
You have completed a goal in step 5
Bolt 9 o'clock back correctly Tightened

VRML action completed goal tightenbolt9 in step 5
You have completed a goal in step 5
Bolt 9 o'clock front correctly Tightened

VRML action completed goal tightenbolt3 in step 5
You have completed a goal in step 5
Bolt 3 o'clock front correctly Tightened

Feedback  Step 5 completed

<Fact-99>
Jess> Advice. Mount dial indicator on back motor bolt on 9 o'clock side
```

Figure 3: Horizontal Parallel Correction Practice Session

Lessons Learned

The VRML External Authoring Interface standard [VRML 1997] is supported by several of the VRML plug-ins for web browsers but is still undergoing revision. We had to experiment to find a combination of web browsers and VRML plug-ins that would support the EAI interface needed for the intelligent practice environment. Consistent browser and plug-in support for the VRML EAI International Standards Organization (ISO) standard would have greatly reduced the experimentation required while implementing the intelligent practice environment.

The mechanical skills training example demonstrates the integration of existing technologies with a minimum amount of software development. With the objective of making 3-D practice environments an affordable training solution, reuse was a prime consideration in the design of the implementation.

- The JAVA applet encapsulating the Jess expert system is reusable and is not lesson content dependent.
- The JAVA EAI event handler applet is reusable. A table linking the Jess fact base with the VRML nodes and sensors in the practice environment is content specific and must be created for each practice session.

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- The rules developed for the sequential activity knowledge base are totally reusable. These rules provide the logic for managing the user activities and VRML objects for a sequential procedure practice environment. The rules also provide the logic needed to determine the advice and feedback requested by the user with the Jess applet interface buttons.
- The fact structure for the knowledge base is reusable for other sequential procedure practice environments. The facts are content specific and must be created for each practice session.
- Reusing 3-D Computer Aided Design (CAD) objects adds realism to the practice environments. Reuse is never easy. The original CAD model designer's objectives are very different than those of a training practice environment designer. Inevitably, the objects must be edited. A good approach is to create a hierarchical scene with each object of interest in a separate VRML file. The 3-D scene is created as a composite of all of the individual VRML objects. The user's interactions are easier to monitor and analyze with a hierarchical scene composition

The implementation example described in this paper was custom crafted as a prototype to learn about the process of adding intelligence to practice environments and to begin to understand the potential advantages of intelligent practice environments. With a well-defined concept for an intelligent practice environment, it will be possible to develop tools that generate the content specific links between the practice environment and a supporting Knowledge-Based-System.

Summary

This paper presented a preliminary intelligent practice environment architecture and provided a review of a 3-D implementation. This example integrated an expert system with a 3-D VRML practice environment. The added intelligence manages the user's activities in the 3-D practice environment and provides dynamic advice and feedback based on the user's activities in a 3-D practice environment. The capabilities required by effective practice environments were identified. The re-use potential was described for the components implemented for the mechanical skills training example. A detailed explanation was given with the facts and rule behavior for a procedural problem solving activity common in mechanical skills training. We identified some of the many lessons we have learned in this process. We are making progress toward our long-term objective to develop realistic practice environments where a user can learn by discovery and gain mission qualifying experience by doing meaningful tasks. Our initial step of integrating a practice environment with an expert system has enabled us to understand the processes and challenges involved with building an intelligent practice environment.

Related Research

There are several research areas that should continue to have a positive impact on our ability to increase the effectiveness of practice environments by adding intelligence. The interaction between man and machine is often viewed as a dialog. An effective practice environment needs to be able to participate in a meaningful dialog with the user(s) in a problem solving session. Two important areas of research aimed at improving the ability for man and machine to communicate are mixed-initiative interactions [Hearst 1999] and intelligent dialog systems [McRoy, Ali, Restificar, and Songsak 1999]. Researchers in these areas are developing new techniques to improve communications between man and machine through more meaningful and flexible interaction strategies. Dynamic, real-time explanations [Callaway, Daniel, and Lester 1999] should increase learning effectiveness for future generations of practice environments. Collaboration among real and simulated users in multi-user worlds is another hot research area. 3-D worlds offer a rich environment for visualization and expression of ideas. The future of 3-D on the web looks bright with the evolving X3D standard [Rahmat 2000]. Researchers have already begun to populate and inhabit 3-D worlds so they can gain knowledge about the unique challenges and potential of 3-D learning environments. Pedagogical agents [Lester, Towns, and FitzGerald 1999] are being created to act as teachers and tutors in future 3-D learning environments. Other researchers are simulating peers for team problem solving activities.

Work with Intelligent Tutoring Systems (ITSs) has been ongoing at MITRE for many years. ITSs emerged in the 1970s to improve Computer Assisted Instruction (CAI) which lacked the skill of human instructors and couldn't model a student's cognitive processes to provide meaningful guidance. Experience has shown it is very difficult and expensive to build an ITS with the student and instructional models necessary to generate useful guidance and advice. The knowledge based component of our intelligent 3-D practice environment could be an ITS in the future. Our proposed architecture paves the way for interfacing 3-D practice environments with intelligent technologies as they mature and become feasible.

About the Author

Janet Faye Johns is a Principal Engineer at The MITRE Corporation where she is responsible for software systems design and development. Ms. Johns has a B.S. in Mathematics, an M.S. in Math and Computer Science, and has completed the coursework for a Ph.D. in Computer Engineering. She has been the vice-chair of the Association for Computing Machinery (ACM) Special Interest Group for Ada (SIGAda) Artificial Intelligence Working Group (AIWG) since 1990. Ms. Johns was the Product Manager for the Shaft Alignment Primer, which was developed to investigate how the latest technologies could be used to teach mechanical skills.

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Evolution of the Walden's Paths Authoring Tools

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Abstract: Changing user skills, available infrastructure, and work practices have caused many differences in the authoring support provided by the Walden's Paths project since its conception. In this paper we trace these changes and the transition from the earlier authoring tools that supported an integrated authoring process, to the more recent tools designed to work with the Web applications that teachers have become accustomed to.

1. Introduction

Hypertext has come a long way from being found only in research systems to being a part of our everyday lives in the form of the World-Wide Web (WWW or the Web). We use the Web for browsing academic information, for furthering business interests, for entertainment and a variety of other purposes. There is an immense amount of information on the Web that can be used for a variety of reasons. Web-based information can be harnessed to supplement classroom teaching for K-12 students. K-12 teachers can use Web-based information in the curriculum to help students learn at their own pace and to make their educational experience a more interactive one [Furuta et al. 97].

While the use of Web-based documents in educational curriculum allows teachers and students unrestricted access to a global information repository, it also raises issues. The Web is a vast and dynamic medium. It can be used as a canvas for exploratory learning. Exploration, a valuable mode of learning, can be more useful to students if it occurs in an environment that the curriculum developer has constrained by providing context and additional structure. Much of the information available on the Web is not oriented towards use in a classroom setting or for comprehension by K-12 students. However, various elements of the available information, for example, collections of images, simulations, multimedia objects, library databases and catalogs, etc., have the potential to play an important role in an educational setting [Shipman et al. 96]. The addition of meta-structure to the existing hypertext network makes it more suitable for exploratory learning.

A path is a type of meta-structure that links conceptually similar information in a hypertextual Web. Bush suggested the use of associative trails as a means to maintain information based on a user's mental model [Bush 45]. Paths have been implemented in Trigg's Guided Tours [Trigg 88], integrated into Notecards [Halasz 87], and demonstrated in Zellweger's Scripted Paths [Zellweger 89].

In the next section of the paper we briefly describe Walden's Paths, a system that allows teachers to add meta-structure over Web-based documents. Section 3 describes the early implementations of the authoring tools and the lessons learned from them. We describe the concept and implementation of a new set of authoring tools in section 4. Section 5 discusses a recent evaluation of the new authoring tools. Section 6 presents directions for future work and concludes the paper.

2. Walden's Paths

Walden's Paths is a Web implementation of a path mechanism. A path is based on the metaphor of a network-based meta-document, where the links from the path point to Web documents. In general, the author of the path is not the author of the documents that the path points to. Walden's Paths currently supports linear, directed paths -- a path is essentially a list of Web pages to be followed in the order of their appearance in the path. Walden's Paths is aimed at incorporating Web-based information in the K-12 curriculum and hence additional text can be added in order to further contextualize the Web-based information. The authors may provide this context by adding text or other annotations to individual pages on the path, as well as by providing an abstract for the path as a whole [Furuta et al. 97]. A detailed discussion of the various issues and experiences with Walden's Paths can be found in [Shipman et al. 96], [Furuta et al. 97] and [Shipman et al. 98].

Walden's Paths (http://www.cs.tamu.edu/walden) can be accessed from any standard Web browser that supports frames. Figure 1 shows a page from a path on the Center for Studies of Digital Libraries. The browser window is split into three frames. The bottom frame displays the Web page that the path refers to, as it would appear when viewed without the Walden's Paths interface. The top two frames help enunciate the contents of the bottom frame. The top-left frame is the "Control Frame". It displays the widgets for navigating along the path and provides an indication of the reader's location on the path. It also provides a link to the page being displayed in the bottom frame in case the reader would like to view the page outside of the Walden's Paths interface. The information icon (denoted by 'i') displays a brief overview of the path that includes an abstract for the path: a short description, followed by the title of each page in the path. The top-right frame is the "Annotation Frame". This frame contains the annotation added by the author. The annotation may be an explanation of the document in the bottom frame, a pointer to more resources, a question that the students may be expected to answer, points to be noted in the document below or any other information that will satisfy the author's curricular goals.

Path readers may navigate the path solely by clicking on the forward and back arrows (in other words, visiting the paths in the order intended by the path author) or by visiting pages in the order of their choice by clicking on the page numbers. A reader may follow any link from the document displayed in the bottom frame and thus explore the space related to the path. When the reader "leaves" the path, a "Return to Path" image replaces the contents of the control frame as shown in Figure 2. Once the reader is done exploring the space he or she may return to the location on the path where the exploring began with a single click of the mouse on this image.

3. Authoring Paths and Earlier Tools

Authoring paths is a complex information task, requiring a number of author activities. In general, path

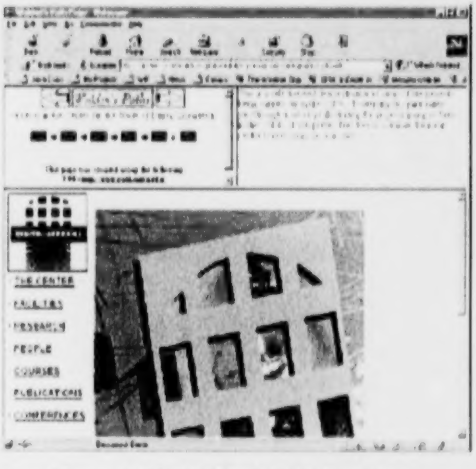

Figure 1: The Walden's Paths Interface

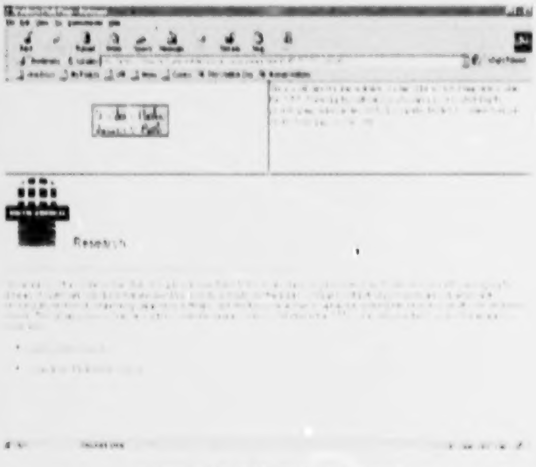

Figure 2: Off-Path traversal

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authoring comprises of the following steps [Shipman et al. 97]:

- Locating promising Web pages
- Browsing and evaluating material at these sites
- Selecting information elements for use in the path
- Developing an outline for the path
- Adding the page URLs and annotations to the paths

Not all of these steps may be required for every path that is authored. For example, if the path author has also developed the pages that contain the information, the location of the information is known. Also, the information has been created for the purposes of the path and there is no need to further evaluate it.

In the past, we have tried various approaches to provide an effective interface for authoring paths. One of these, the Path Authoring Tool, allowed authors to search for Web resources and group selected resources along with their annotations, into a path. The interface for this tool is shown in figure 2. The tool queried Web search engines for finding information on the keywords specified by the author. The list of pages returned by the search engines was displayed in the Search page list (top-left of the window). The pages could be shifted into the path or workspace areas, where the author could add annotations to the page. The authors could store potentially useful pages in the workspace area for later inclusion in a path. The pages in the path could be selected for viewing or modification and the information about this page was displayed in the Information panel at the bottom of the window.

An alternate version of organizing information was tried using an enhanced version of VIKI [Shipman et al. 95]. VIKI is a hypertext system designed to support information analysis. It provides users with the ability to place and move information symbols in a set of two-dimensional spaces called "collections". It then uses a spatial parsing algorithm to identify structure that is implicit in the layout of information symbols. VIKI was enhanced with an interface to Web search engines (AltaVista and OpenText) and a "Save As Path" capability to support authoring of paths [Shipman et al. 97].

This authoring tool performed the search and returned the results in a VIKI collection. The author could then organize and annotate the results in the workspace. This workspace could then be saved either as a VIKI collection for continuing work later or saved as a path. This tool also allowed the author to create paths containing either a selected subset of the pages in the workspace or containing all the pages that had URLs associated with them [Shipman et al. 98]. Thus the author could store other information in the VIKI collection for reference purposes. This approach was promising, although VIKI's implementation on Sun SPARCstations

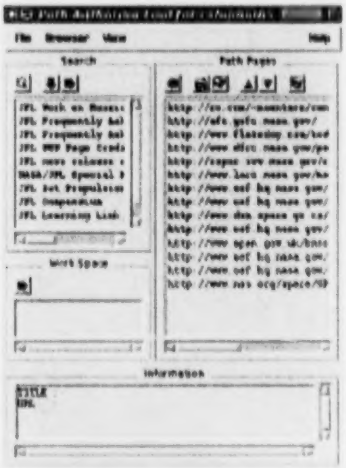

Figure 3: The Path Authoring Tool

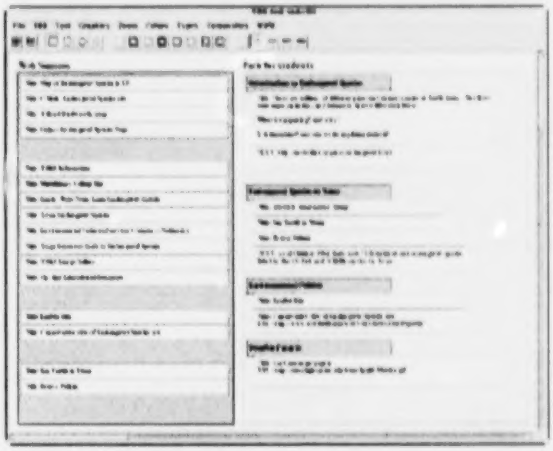

Figure 4: The VIKI-based Authoring Tool

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limited its portability. The recent implementation of VKB [Shipman et al. 00] may allow further investigation of this approach in the future.

The earlier authoring tools provided integrated support for all the steps involved in authoring. However, the process of authoring consists of three operational phases (distinct from the steps mentioned above). In the first phase, the author collects information from the Web for adding in the path. In the second phase, the author creates the path from these resources and stores it in the local file system. In the third phase, this saved path is moved to a Web-accessible location and is registered with Walden's Paths. The new generation of authoring tools separates the three operational phases.

4. The PathAuthor and the PathPublisher

The earlier authoring tools explicitly supported authors in their search for pages to include in the path by providing a built-in interface to search the Web. When we began the project in 1995, teachers were not accustomed to using the Web and so the authoring tools provided a uniform interface to Web search engines to avoid requiring teachers to learn too many new interfaces. In developing the new authoring interface, we recognized that teachers today were likely to be very comfortable with Web searching, and indeed that each individual has his or her own preferences for favorite search engine. Rather than attempting to provide universal support for searching within the authoring tool, we decided instead to assume that information location could and would be handled outside of our system. As a useful side effect, this design decision allowed specification of an authoring interface that did not require an active network connection, thereby opening up the possibility of allowing path editing to occur offline, for example on a laptop located at home. Additionally, it removed the technical requirement that the authoring tool's interface be continually modified to keep up with the changing interface to externally-maintained search engines and eased concerns about compromising the intellectual property rights of the owners of the search engines.

The support provided by our new authoring tools begins with creation of the path from the Web documents selected in the first phase. Once the author has decided which Web pages to use for the path, these pages may be ordered and the annotations may be written even in the absence of a network connection. In addition to the information collected by the previous authoring tools, the PathAuthor collects additional meta-data about the path. This includes contact information about the author, which is displayed by Walden's Paths if a viewer wishes to see the path overview. Walden's Paths uses caching to improve the response time. A page is cached the first time it is accessed and from then on it is served from the local cache. Thus, if a page changes after it has been cached, the viewers of the paths cannot know about it. However, if the authors want to include periodically changing information, it presents a problem with the current path structure. Hence, the new authoring tool accepts a caching period from the author, the amount of time after which, the page must be fetched again from its location. The paths that are created may also be valid only for certain duration. For example, the author may not wish to have a path for the solutions to student assignments available beyond the

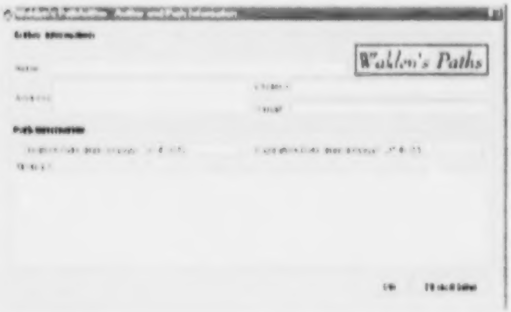

Figure 5: Author Information Dialog

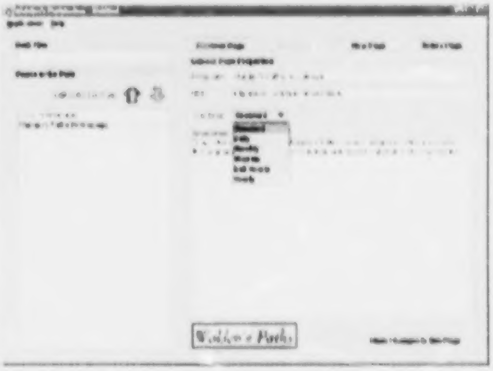

Figure 6: Walden's PathAuthor

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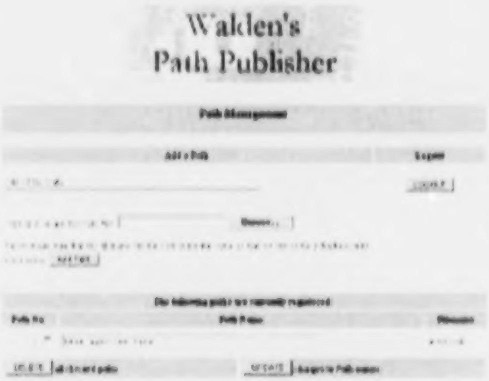
end of the current semester. Hence, the path may have an expiration date. The Author Information Dialog is displayed in figure 4. All of this information is voluntary -- paths may be authored without this information.

The PathAuthor is a network-independent stand-alone Java application. It is backward compatible and reads paths that were created using the earlier authoring tools. When such paths are saved, they are saved in the new format and hence the PathAuthor also acts as a path upgrade tool. The interface of the PathAuthor is illustrated in figure 5. The PathAuthor is platform-independent, as it has been implemented in Java, and it automatically adjusts the window size depending upon the size of the display. It currently supports three screen resolutions, 640 X 480 pixels, 800 X 600 pixels and 1024 X 768 pixels. For any other display sizes, the interface selects the most optimal display parameters and adjusts to the display. The interface supports the addition of new pages, the modification of page properties like Title, URL, Caching and Annotation, the deletion of existing pages, the retraction of all changes to a page, and the reordering of the pages in the path.

The PathPublisher supports the authors in publishing their paths that have already been saved in their local file systems. It is implemented as a CGI application and can be accessed from anywhere via the WWW. The authors must login over the WWW with a login name and a password in order to publish or unpublish paths. The paths so published are displayed in the author's personal list of paths. The authors may also modify some of their user settings, for example the password or change the titles of the paths. The PathPublisher also features an "Administrative" interface that allows an administrator to log on remotely and add/delete author logins or modify their settings. The administrator may also add paths that are visible in the global space (from the main list of paths). We are currently not considering security issues beyond the login procedure, as these can be handled by the use of existing technologies like SSL (secure sockets layer). Figure 6 illustrates the interface of the PathPublisher.

5. Evaluation of the new authoring tools

Intermediate school (5th and 6th grade) teachers in the College Station Independent School District (CSISD) evaluated the new set of authoring tools and tested their usability. The teachers fluently used Web search engines to find resources for their paths. They found the authoring tools easy to learn and were able to create and publish paths using these tools in a short time. The teachers suggested addition of new features to improve the utility of the authoring tools. They suggested that the PathAuthor support a drag-and-drop feature to copy the URLs of the pages directly from the browser window. Currently the authors can add any amount of text on one line in the annotation area. This feature allows authors to include lengthy HTML tags within their annotations without having to break them up across lines. The teachers would like an additional "text" mode for the annotations that would wrap the text after it spanned the width of the window. They also identified potential usability problems with the tools and these will be fixed in the near future.



Walden's
Path Publisher

Figure 7: Walden's PathPublisher

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6. Conclusion and Future Work

The expectations of users from the software they use change over time. This is partly due to the changes in their knowledge, in their work practices, and in the infrastructure that is available to them. In the Walden's Paths project, we have observed these changes and have modified the functionality offered to the authors to best support their needs and work practices over time. The earlier versions of the Walden's paths authoring tools were designed to support users who were not conversant with the use of the Web and hence provided a more protected environment in terms of interacting with data on the Web. The later tools focus more on supporting the authors in the process of path authoring and rely on authors to be able to gather the information that they would like to go in their paths. This also offers more flexibility and freedom to the author as regards their preferences in collecting data over the Web. As evaluation of the new tools takes place, we will watch for signs that teachers are having trouble searching for information or would like a workspace for storing pages of potential future value with the path.

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Electronic Commerce in Australia – Trends, Developments and Challenges

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Abstract: The growth of electronic commerce (e-commerce) is phenomenon primarily in the USA. The Australian position in the era of e-commerce is promising and improving rapidly. The digital economy based on globalization and Information Technology is influencing the Australian Government to take a greater role in shaping the blueprint for e-commerce. It is very interesting to note that Australia embraces new technology very quickly. For example, Australia has the 3rd position in the percentage of Internet use just after the USA. As revealed in a recent survey, many potential customers in Australia are reluctant to do business on the Internet due to security concerns on online payment systems. Despite concerns, only 20 percent of businesses in the Asia-Pacific region had formal security strategies and policies compared with 35 percent globally. Australia has also chronic skills shortage. The aim of this paper is to provide a snapshot of the current status of e-commerce globally with special reference to Australia. The author points out also opportunities & challenges concerning this online business.

Introduction

The Internet is driving economic growth at an unprecedented rate in the USA. Australia along with many other western countries are also enjoying the benefit of the explosion of Internet use. It is creating a huge market in cyberspace and carries valuable information to a large number of people all over the globe. Telecommunications technology has turned the world into a global village. The entire world is getting networked. Furthermore, the individuals and organizations will become more and more location-independent for their information needs and performing their roles in the society and economy. The paper outlines the recent development of e-commerce in Australia and identifies major trends and challenges concerning this online business. The author provides also a brief overview on recent development of e-commerce globally.

The World Wide Web & E-commerce

With the emergence of the World Wide Web (WWW), a totally new global business culture and environment are emerging. The new way of doing business across the globe is called Electronic Commerce (e-commerce) or Online or Internet Commerce [Roth, 1998]. E-commerce is accelerating the growth of digital economy. 'The Age of Networked Intelligence is an age of promise' as predicted by Tapscott [Tapscott, 1996]. E-commerce is a technological wonder for benchmarking and productivity improvement [Karmakar, 1999]. It helps to achieve greater production and distribution efficiencies. All contemporary production methodologies are dependent upon highly dynamic information flows in supply chains. E-commerce also helps to keep reduced inventory and thus lowering operating costs for the company [Mougayar, 1998].

Randall Whiting, president and CEO of Commerce Net states:'Electronic commerce is about a global electronic marketplace that enables all members of a value chain to interact spontaneously for mutual benefits. It provides an environment where customers are empowered to control the buying process more effectively, receiving and accessing personalized information. It provides a platform for complete *relationship management*, not just a one-time transaction.'

The Web is the key player in bringing e-commerce. It has been reported that 1.5 million new web sites are being created every day. Web sites vary considerably in size and content. The potential savings through the use of e-commerce have been calculated to be as high as:[1]

- Airline tickets: 87 per cent,
- Banking transactions: 89 per cent,
- Bill payments: 71 per cent,
- Software distribution: 97 per cent.

Current Status of E-commerce: a global overview

E-commerce is growing dramatically and it was approximately U$43 billion in 1998, but it is estimated that online business may sour to U$1.4 trillion by 2003[Los Angeles Times, 1999]. It promises to radically redesign business processes to do business in the connected world [Kambil, 1997]. E-commerce still represents a relatively small percentage of the total commerce market, but it is significant and growing exponentially. With the growth in Internet usage, there is a corresponding increase in e-commerce. A recent by Angus Reid survey of 28,374 worldwide Internet users, or about 200 Internet users in each of 34 countries gave the following statistics for adults shopping online (Gengler, 2000):

United States: 31%, Sweden: 21% Switzerland: 19%, Canada: 18%: Australia: 14%

Traditionally both Australia and Canada are smart in the adoption of new Technology [Karmakar & Fertuck, 1998]. Japan's Ministry of International trade and Industry estimates e-commerce could account for business worth 3.16 trillion yen (about U$18 billion) by 2003 (Zielenziger, 2000). According to the Organization for Economic Co-operation and Development (OECD), the economic performance of countries like Canada, the USA and the UK now compares favorably with that of former leaders Japan and Germany, and a significant part of this is their aggressive exploitation of IT (Norris & West, 2000).

It is to be noted that the National Information Infrastructure (NII) are being linked to the Global Information Infrastructure, predominantly for conducting e-commerce (Bajaj & Nag, 2000). The IT manufacturer Cisco Systems sell products to the tune of US$ 1 billion per year via e-commerce. Dell Computer sells PCs worth a million dollars every day on the Web. Netscape not only sells, but also transmits its products from the Web because they are digital. Outside the digital technology sector, e-commerce on the Web is being conducted in the following sectors:

- ✓ Financial services
- ✓ Books
- ✓ Travel
- ✓ Cars
- ✓ Retailing
- ✓ Advertising & marketing
- ✓ Music
- ✓ Pornography

The USA is the leader in driving e-commerce due to its dominance on the Internet. Currently over 80% E-Business is taking place in the USA. Spending on online grocery purchases in the United States is forecast to grow from less than $US200 million in 1999 to more than $US8.8 billion in 2004.[2] In the first quarter of 1999, 40 per cent of US consumers who purchased a car or truck used the Internet to conduct pre-purchase research.[3] A new report by the US Department of Commerce – *The Emerging Digital Economy II* says online sales will be about $US300 billion annually by 2005. In 1998, online retail sales in the US barely reached $US8 billion (Hollands, 2000).

In 1999, the estimated sales volume of business-to-business electronic commerce was about $US145 billion (A$ 241 billion) and by 2004, the volume of transactions could be as high as $US7000 billion (Corben, 2000). The amount of all e-commerce that is conducted between businesses is estimated to be around 78 per cent.[4] The potential of E-commerce is even hard to dream about. John Chambers, President and Chief Executive of CISCO said, ' We have the power in our hands to make the first industrial revolution look small.'

The Internet has brought established firms huge opportunities as well as threats. It offers ways of reducing costs and of making products in an efficient way. But the online business is not yet completely safe and secure.

In summary, there are a large number of people on the Internet across the globe and more are joining daily. Internet demographics are changing rapidly and becoming mainstream. The development is very rapid among many developing countries, for example, China, India and Malaysia. Content on the Web is growing at an explosive rate. These numbers combined with the nature of the Internet as an information-sharing tool, and potential as a medium for transactions, create an attractive electronic marketplace (Adam et al., 1999). By implementing an Electronic Commerce initiative, organization aim to (Parekh et al., 1997):

- Save costs
- Address new markets and revenue opportunities.
- Improve operating to efficiencies in existing ways of doing business

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[1] Source: OECD reports

[2] Source: IDC research report

[3] Source: Nua Internet Surveys, 1999

[4] Source: OECD research

Despite a number of challenges, e-commerce is already in good shape and growing rapidly. The role of governments in e-commerce is being widely debated worldwide. Attempts are being made to formulate an international policy, because of the global nature of e-commerce (Alliance for global Business, 1999). A number of key committees, comprising major government and industry representatives have been formed. They are considering such issues as the legal framework, taxation, intellectual property protection and the removal of barrier to competition (Lawrence, et. al., 1999).

Development of E-commerce in Australia

Australian businesses are moving rapidly to participate in electronic commerce activity-as providers of goods or services The Australian position in the era of e-commerce is promising and improving rapidly. According to a recent survey Australia ranks 3rd in the use of the Internet around the world.[5] The same survey states that the United States of America ranks 2nd after Finland with respect to the number of households with Internet access. Internet use is changing dramatically. Some three million Australians connected to the Internet at some time in the year to February 1998.[6] Australia's Internet users are expected to be 5.8 million by 2002, according to International Data Corporation [Manktelow, 1998]. Australia has embraced electronic commerce and takes several steps to have proper place in this E-business. The number of people using the Internet in 1999 to buy goods and services was three times that of the year before, at nearly 6 percent of all Australians according to the figure released by the Australian Bureau of Statistics. About 34 per cent of those spent more than A$500 in that time (Jackson, 2000). Australian companies are comparatively slow in positioning for e-commerce initiatives. But the National Office for the Information Economy in the Department of Communications, Information Technology and the Arts, together with 13 industry partners, has funded a pilot study into the economic impacts of electronic commerce. This shows national Government's commitment to enter e-commerce race.

Australian companies are relatively well placed to compete in the era of e-commerce. A recent research report predicts that spending will reach A$6.5 billion by the end of next year and about A$34.5 billion by the end of 2002. Such figures point to a buoyant future for e-commerce, however some industry observers warn that success is not guaranteed.[7]

The digital economy based on globalization and Information Technology is influencing Australian Government to take a greater role in shaping the blueprint for e-commerce. Australia's information economy policy, Investing for Growth was released by the Prime Minister, Hon'able John Howard in December 1997. The Government is committed to providing a light-handed regulatory framework to support and encourage the development of electronic commerce.[8]

The Electronic Commerce Expert Group was established by the Attorney General to report on the legal issues arising from the development of electronic commerce. The Attorney General Department is developing legislation, in consultation with the States and Territories, to remove the legal obstacles to the development of electronic commerce in Australia. It will take the form of a uniform model law for adoption in all Australian jurisdictions. It has put most of the legislative infrastructure in place to facilitate industry adoption of e-commerce within a secure electronic trading environment.

Dr. Paul Twomey, the head of the National Office for the Information Economy (NOIE) in Australia said billions of dollars could be saved by adopting e-commerce [Lynch, 1999]. The priority industry sectors for the impact of e-commerce are banks, communications, government, education, transport, health & professional services. Internet penetration is reaching a point where e-commerce applications like banking and share trading are accelerating quickly (Tebbutt, 1999).

A recent study by GartnerGroup has found that online spending by Australian consumers has reached $US1billion for the first time and will grow to $US7.6 billion within five years [Grayson, 1999]. The GartnerGroup research also found that annual business-to-business e-commerce spending had reached $US3.6 billion and would rise to around $US44.8 billion by 2003.[9] This compared with annual business-to-business e-commerce spending of $US12 billion for the Asia Pacific region in 1999. This was the forecast to explode to $US280 billion by 2003.

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[5] Source: Network Wizards; Killen &Associates, 1997

[6] The Australian Bureau of Statistics, May 1998

[7] http://www.eds.com, www.forrester.com, www.3com.com

[8] http://www.law.gov.au/ecommerce/legal.html

[9] http://www.gartner.com

The strong growth in the use of e-commerce by Australian consumers could be attributed mainly to a number of factors:

- High percentage of Internet use,
- Easy to use,
- Widespread acceptance of credit cards,
- User-friendliness.

The people will spend more online as the people become conformable with the technology. Australian Internet Service Providers would be in a strong position to act as supplier hubs for small and medium sized businesses. Australia has also the potential to be an Asia Pacific regional hub due to its strong skills base and high quality telecommunications infrastructure.

Trends & Challenges

The Internet and related markets are growing exponentially. Electronic commerce provides consumers with convenient shopping methods, from online catalogue ordering to phone banking, both of which eliminate the costs of expensive retail branches [Kalakota & Whinston, 1997]. Electronic commerce is now a valuable business tool to run business in a cost-effective way and thus providing consumers goods at home at a reduced price. Now there is a true convergence of computers, communications businesses. Electronic commerce presents ongoing challenge to the international legal systems. It represents major threats concerning privacy and security. It is a business without a boundary, so concerns are the collection of the sales and other taxes and secured electronic transactions.

Australian trend to e-commerce is exciting. There were A$250 million of online business-to-consumer sales by Australians in 1998. It was expected to be more than A$900 million. That is still less than 1 per cent of the total consumer retail spend, which is $150 billion to $170 billion a year in Australia [Foreshew, 1999]. One of the most popular online shopping purchases in Australia recently was wine. In the past 12 months about 2 percent of Internet users here have bought wine, or about 30,000 Australians. Other sought-after items online include books, software, music, magazine subscriptions, concert or event tickets, stock or stock information, games, travel, clothing, flowers, classified listings, food and groceries.[10] Internet travel would have its Australian boom as the market matures. Australia's first locally backed, person-to-person online auction service, stuff.com.au, is attracting up to 30,000 users a day.

Australia's revenue from e-commerce is predicted to surge to $US 207 billion ($A345 billion) by 2004 and more than 16 per cent of total sales will be online locally according to a recently published finding of Forrester Research.[11] But, such growth requires public policy support, low barriers to trade, stable currency, flexible currency markets and – most of all – a technology infrastructure to reach its full potential (Yelland, 2000).

Australia is facing a number of challenges. The foremost among them is the shortage of meeting the Digital Workforce. A report recently released by the Australian IT & T industry Skills Taskforce has estimated around 30,000 additional IT employees will be required over the next 12 months, 88000 over the next three years, and more than 169,000 by 2004. Tertiary institutions are graduating only about 10,000 students annually (Williams, 1999). One recent figure for the shortfall was more than 41,000 staff. Australia is losing 2500 IT professionals to the US each month (Double, 2000). Australian industry players warned that a recent move to loosen US immigration laws would only exacerbate the shortage of skilled local workers, with some highly competent IT professionals taking the opportunity to migrate (Hayes, 2000). The Australian utility companies are falling behind their United States counterparts in internet innovation at an alarming rate, according to Anderson Consulting. Australia is slowly catching up with the USA.

Most traditional Australian firms do not have a culture of competing on price or of really letting the savings flow through to the consumers. Firms all over the globe will benefit from improved access to international markets. There will be tremendous competition for product markets and firms need to exhibit flexibility to cope with those challenges.

Electronic commerce presents fundamental challenge to the law. The suitable law should tackle the threat of security and privacy when we do business online in the digital economy [Karmakar et al., 1997]. As revealed in a recent survey, many potential customers in Australia are reluctant to do business on the Internet due to security concerns on online payment systems. Despite concerns, only 20 per cent of businesses in the Asia Pacific region had formal security strategies and policies compared with 35 per cent globally (Jackson, 2000). The majority, 69 percent of companies worldwide had no security policy in place.[12] But for anyone to benefit from E-commerce, electronic payment mechanisms must be reliable, secure and easy to use [Clarkson, 1998].

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[10] www.consult.com.au, www.chaosmusic.com, www.travel.com.au,www.stuff.com.au

[11] www.forrester.com

[12] www.deloitte.com.au

Australia has introduced Good and Services Tax (GST) since July 1, 2000. This unpopular tax may cause harm to E-commerce. This will be a disaster for Australian economy (Foreshew, 2000).

Conclusions

Global information infrastructures are rapidly becoming a reality to run business electronically. Australia can overcome its isolation to take part effectively in electronic commerce. E-commerce can play a role in reducing costs, improving product quality, reaching new customers or suppliers, and creating new ways of selling existing products (Schneider & Perry, 2000). For consumers, e-commerce promises a great deal. It offers the convenience of on-line shopping and ordering as well as the ability to quickly compare products and prices. For retailers and other businesses it provides a totally new channel to reach customers as well as providing a cost-effective mechanism for serving them. There will be more business-to-business transactions than consumer-to-business e-commerce and this will create true network economy (Hollands, 1999). Selling the products of many firms on the Web are growing exponentially. Doing business on the Internet should be easier, fairer, safer and legal. But a booming e-commerce market also means an exponential increase in risk. For most end users, the convenience and benefits of electronic commerce will soon outweigh risks, thus giving rise to an Internet commercial explosion [Lane, 1998]. Finally, it is worth remembering a quote of Bill Gates, Microsoft Co-Founder & Chairman: 'Going digital will put you on the leading edge of a shockwave of change that will shatter the old way of doing business. A digital nervous system will let you do business at the speed of thought, the key to success in the 21st century'.

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Rapid Development of Web Applications with Object Thinking

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Abstract: Many people want to quickly prototype web applications due to rapidly changing audience and needs. Comanche introduces an object-centered framework. Comanche applications manipulate objects and Comanche takes care of protocol specifics. This allows programmers to view the web as a distributed network of objects, independent of location and protocols.

Comanche offers a highly flexible framework for web application development. It provides handlers at several layers that manage the technical complexity and details of protocols, enables an object view of the web and local resources, and empowers developers to focus on the task.

Introduction

A typical web development project involves many steps, most of which are not directly related to solving the task at hand. A developer has to worry about HTTP protocol specifics (headers, cookies, sessions, status codes, etc.), application logic, storage/persistence mechanisms, database connectivity, page layout, multimedia, and more. From the early days of CGI to this day, these details keep focus away from the problem and bog down productivity.

In our quest to simplify and speed up web application development, we decided to part from the traditional approach. By changing the way developers reason about web application development and web applications themselves, we will improve their productivity. Elimination of unnecessary logistical and protocol worries reduces overhead and allows developers to focus more on solving domain problems.

Web application development remains a craft of a few. Even amongst the craftsmen, task at hand occupies only a small portion of time and effort, which are primarily expended on dealing with HTTP protocol details, HTML quirks, development environment intricacies, etc. We believe that removing this overhead and presenting a cleaner way of programming web applications improves productivity and allows quicker prototyping.

To improve productivity, we present object view of the web, introduce web design patterns, and allow developers to have "business as usual".

Object Web

Comanche manipulates objects as the first class citizens. Only application-relevant issues should be of concern to the developer. Protocols, formats, and other extraneous items should be handled transparently. Comanche supplies HTTP framework, but its applications are largely unaware of the protocol specifics. Applications handle requests and transactions that are native to them, manipulate objects, and return results in objects. The protocol framework translates the results into the specific protocol's friendly format, e.g., for HTTP, the following formats are acceptable: HTML, text, image (GIF and JPEG).

Comanche enables an object view of a web application: A web request is an object, applications return objects in response to requests. Core HTTP protocol support framework makes bi-directional conversions that take care of details. An incoming request is read, interpreted, and converted into an instance of

HttpRequest. The latter, in turn, is offered for application modules for processing. An application module's filter determines if it is responsible for serving the request and processes it if necessary. The return result of the application's process method is passed on to the HTTP protocol support framework, which converts the return object into an HTTP suitable form. For example, Strings are sent as content-type HTML, Forms (objects for storing images) are sent as content-type JPEG or PNG, etc.

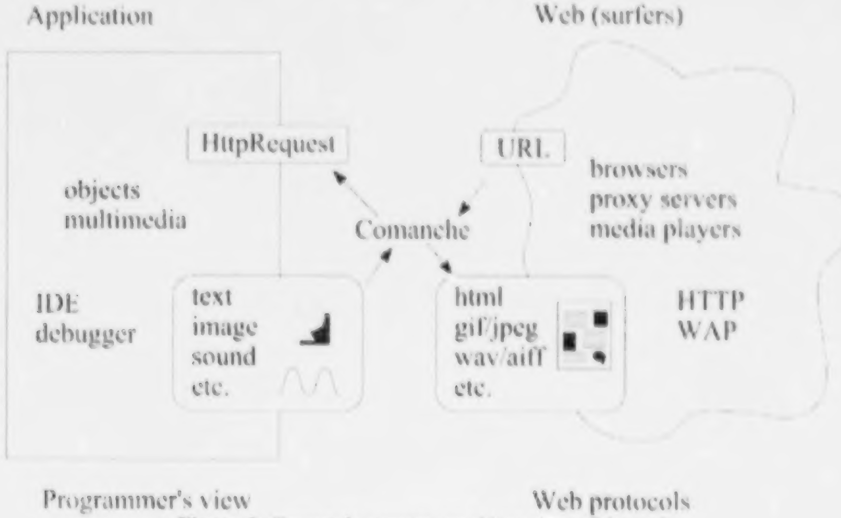

Figure 1: Comanche creates an object view of the web.

Applications may define their own request classes. This further aids abstracting the application design from specifics of the protocol. The application's filter not only checks if the incoming web request (HttpRequest) is to be processed by the application, it also converts it into the application's preferred request format prior to passing it on to the application module. For example, a static file serving module, FileServerModule, defines FileServerRequest class.

This approach requires writing conversion methods for a number of classes. Comanche provides conversion mechanisms for several base classes, including media, text, streams, files, exceptions. For the classes that are not explicitly supported, the default conversion method raises an exception, "Unimplemented". Thus, making a new class Comanche-friendly requires writing conversion methods. Furthermore, each new protocol potentially requires new conversion methods. However, once such conversion method is written, the technical details of the conversion are hidden and can be reused.

Comanche lets the developer focus on the task. Unessential aspects are taken out of the way. The framework manages the protocol details and converts requests into a digestible form. Furthermore, Comanche enables and encourages developers to view the web as an ocean of objects.

Extending the object view to external resources allows a seamless integration of databases, file systems, and other resources. External resources are accessed through proxies that are modeled as familiar objects in the system. For example, a database table proxy supports a collection protocol, translating between collection operations and database queries.

Comanche is built in Squeak, a flavor of Smalltalk. Comanche inherits Squeak's rich multimedia support. The obligatory "hello world" example is fairly trivial (double quotes designate comments in Smalltalk):

```
process: request "method header"
    ^'Hello World!'   "return String 'Hello World!'"
```

Request is encapsulated as an object, shielding the application and developers from HTTP (or another protocol) specifics. However, there are situations when such details are necessary, for example, in service application modules to handle security and access control. Since Comanche allows developer to completely redefine any aspect of the system, the web application can be tweaked to any specific needs. For common cases, it provides solutions that can be readily reused. Applications can take advantage of message encapsulation in the HTTP requests.

Business as Usual

While web application development differs from development of an accounting system, certain fundamentals remain the same. Comanche minimizes web/HTTP centricity, allowing development as usual, using objects, methods, messages, exceptions, etc.

How should errors be handled? For example, if a page is not found, you may want to present a special interface, such as a page that informs of the error and offers search and other links. HTTP error codes and other error conditions are mapped into the language exceptions. This allows using the same framework for stand-alone GUI applications. Furthermore, because these exceptions are objects, to return an HTTP error page they are caught and returned as responses to the HTTP request.

Error handling is another issue that warrants a special attention. What is a natural mapping from HTTP error codes (e.g., 200 is success, 404 is page not found) to the language constructs? An obvious solution is to use exceptions. Comanche introduces a set of exceptions that correspond to HTTP error codes. The HTTP protocol framework intercepts exceptions and if they represent a return status (HTTP error code) rather than some other exception, they are converted to an equivalent HTTP response (e.g., 404 Page Not Found, etc.).

For development purposes, the exception catching can be turned off, so that errors show up in the debugger. This also makes it possible to cut off some protocol conversion overhead when the client resides in the same environment as the server, which may be the case on a development station.

Case study: sharing personal dynamic media

Suppose you decide to create a graphic design tutorial and share it on the web. You create presentation slides that feature flash animation, photographs, and tutorial text. An easy way of manipulating these items would be creating a folder that contains the artifacts and designating that folder for sharing on the web. As a complete environment, Squeak allows one to do art and web hosting in the same place. Thus, the artwork that effectively conveys your tutorial is constructed of objects, which also know how to render themselves on a web page. The presentation slides become individual web pages. Their content is formatted according to the capabilities of the browser: links for download or embedded for immediate viewing. All that without losing control or view of the artwork: to remove a slide, just drag it out of the presentation and out of the folder, to add, grab one from outside. To make another presentation available, drag it into the shared folder.

Case study: Swiki, web collaboration done right

A very successful web application developed for Comanche is Swiki, developed by Jochen Rick. Swiki concept is based on WikiWikiWeb (a.k.a. Wiki) by Ward Cunningham. Wiki allows users to view and edit web pages in the web browser. Swikis are widely used at Georgia Tech and a number of other universities.

Comparison to other technologies

WBI (see WBI) (Web Intermediary) framework introduces "intermediaries", which act as pipes or filters of HTTP streams. For example, an intermediary could remove images the HTML document (e.g., for wireless portable devices). This approach is particularly useful to use the data resources of the legacy applications that cannot be easily modified. Furthermore, it utilizes a common batch processing paradigm, which makes it easy to adapt to new situations. However, these same features that make it useful for batch-processing and filtering, make it ill-suited for developing new applications.

Latest Java servlet API (version 2.2 as of writing of this paper) supports pluggable web applications that can be deployed in a server-independent manner. "A servlet can almost be thought of as an applet that runs on the server side" (see Java Servlet API). Typical servlet based application development involves creating an index.html file (application root), several Java server pages (JSP) files, Java beans, compiled Java classes, and servlet code. The application is packaged in a Web application archive file. Servlets write directly to the response stream and may use template or JSP files to format their HTML output. This model requires creation, modification, and management of several resources (all the files). A developer devotes a lot of attention to logistics of the application development and deployment rather than application logic. Modification of the application logic may require changes in several locations (including the servlet code, JSP files, beans and compiled classes).

Various server side and embedded scripting languages (ASP, PHP, ColdFusion, JSP, EmbPerl, etc.) embed source code into HTML files. Before the HTML file is sent to the client, the code is executed and replaced with its results. In most server side scripting and all embedded languages, an existing language or its subset is used (JSP uses Java, ASP uses a dialect of VisualBasic, PHP uses a language similar to Perl, etc.). This approach splits the application into a series of files, each of which performs a limited number of tasks, usually one. Simple applications may consist of just one page, such as 'Hello, YOUR NAME HERE'.

While using scripting languages is appealing, this approach suffers several shortcomings. Most existing development tools (for the embedded language) cannot be used because of the changed format (and occasionally, syntax). Complex applications that contain more than a few simple pages increase the developer's overhead to manage various files and resources. HTML and all application logic code are incorporated in the same files, which makes it harder to customize or modify individual aspects of the application. Furthermore, reuse of applications under a different environment is difficult.

Attempts to introduce object technologies (CORBA, COM) focused on the issues of software engineering of large scale projects, and did not necessarily consider ease of understanding the process. Developers have to follow a complex set of conventions to ensure interoperability of their solutions. Several academic and research project also attempted to address issues that Comanche tackles: support for web standards and adaptability to other protocols (see Hester), object oriented programming (see Müldner), and rapid development (see Pour).

Conclusion and future work

Comanche is a cross-platform web application server. It runs identically on Windows, UNIX, Mac OS, and a number of other platforms. Its model affords development of applications that can be deployed in a variety of environments, such as HTML browsers, WAP devices, etc. Support for new protocols can be added by simply adding the interface with that environment, without a need to change applications.

Comanche aims to provide a robust platform for rapid prototyping and development of web applications. Support of a clean framework for such applications not only improves their design, but also makes possible rapid authoring of applications. Our specific aim is to research and develop collaborative applications. Comanche allows us to quickly prototype the application to test our new approach. Furthermore, the applications and their components can be evolved or reused. For example, embedded scripting is used for constructing HTML page templates and to develop applications.

The current approach to address legacy data sources is to first attempt to fit them into one of the already supported categories, or to develop code to support them. One possible solution is to create gradually increasing support for unknown data formats.

(A-la Dynabook) What would happen in a world in which everyone had Comanche? Any user could mold and channel the power of the computer to share dynamic media in accordance with his/her own needs.

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MyXML: An XML based template engine for the generation of flexible web content

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Abstract: MyXML is an XML/XSL based template engine that facilitates the rapid development of flexible, database-backed web sites. A strict separation between content, layout and business logic of a web site is enforced. As a consequence, changes in the layout no longer affect the content or the logic of a web site and vice verse. On the basis of our web service engineering experiences with the Vienna International Festival Web Service we designed and implemented MyXML to provide a language independent abstraction of frequently needed web functionality. Also the creation of dynamic web content based on CGI and database access as found in many of today's web sites is supported. MyXML can be used with arbitrary programming languages. Additionally, MyXML can be used to directly generate XML content for further processing from relational databases.

Introduction

World Wide Web services and hypermedia applications are information systems that are based on a highly dynamic and flexible medium. They often have to provide interactive and up-to-date content. Managing and maintaining a web based service can be a difficult task once the size of the presented information exceeds a certain limit. Flexibility in terms of layout and functionality is a basic requirement for web applications. Applying changes to both static and dynamic components of a web service while keeping a common look (corporate design) and functionality can be a tedious and difficult task.

The last couple of years have shown the emergence of new technologies and tools for the creation of static and dynamic web content. A large variety of WWW services, applications and tools have been flooding the Internet for the last few years. The rapid development of flexible and scalable web sites is becoming a key success factor in the online commerce business.

Our group has been managing, hosting and building the web presence of the Vienna International Festival (VIF) since 1995 (Schranz 1997, Schranz 1997a, Schranz 1998). The site of this international festival consists of many dynamically updated information pages, bilingual content, some multimedia data and several interactive services. One requirement for such a service is the high level of necessary flexibility both in respect to layout and functionality changes. This requirement comes from the fact that the VIF look and feel has to change *every year*. We found that this task cannot be satisfactorily achieved by the deployment of popular web engineering tools. In the past, we designed and developed tools (HTML++ (Barta 1995), JESSICA (Barta et al. 1998)) to provide web engineering and flexibility support for a complete web service. One drawback of our tools, like many other web engineering tools, has been the unsatisfactory support for a complete layout, content and logic separation.

The wide acceptance of the XML (W3C 2000) standard by developers and the large growth in its use recently has brought with it proposals and tools to enable a strict layout, content and business logic separation in web applications (Mazzocchi 2000, Mazzocchi 2000a, Mazzocchi 2000b). Nevertheless, most of the current popular technologies for building web applications like PHP, ASP, JSP, JavaScript, Perl, Python and Java servlets still do not have support for this separation. The layout, content and the logic are mixed together in one or more files which complicates the task of applying changes. If you have to do layout modifications, for example, you have to analyze the source code and to try to locate the encoded layout information. Then, you have to modify your layout and this often forces you to alter your functionality. To cut down the development time when migrating the VIF web site to a completely different look and feel and to be able to adapt rapidly to changing layout requirements, we developed an

XML/XSL-based template engine. The MyXML template engine attempts to solve this flexibility problem by using a combination of XML, XSL (W3C 2000a) and the MyXML language for developing web services. The system architecture is programming language and database independent. We have implemented a prototype that has support for Java servlets and that has an interface to the MySQL freeware DBMS (tcx 2000). The latest version of MyXML is downloadable at http://www.infosys.tuwien.ac.at/myxml/. Our system aims at automating processes that are frequently needed in building static as well as dynamic web sites.

The MyXML Template Engine

MyXML uses a layered approach to achieve a separation between the static and dynamic information offered in a web site and the layout it is presented in.

The content is represented in special MyXML documents. These documents are well-formed XML documents that contain the structured content. MyXML documents can also be based on a document type definition (DTD) (W3C 2000b) that defines the content's overall structure. The content itself can be enriched with special MyXML elements which represent template functions like variables, loops, and database queries and enable the user to add dynamic content to a web site. These elements are defined in the MyXML namespace and are described in the next section. All the necessary layout information is added to the content defined in MyXML files as separate XSL documents. XSL transformations are much more powerful than cascading style sheets (CSS) (W3C 2000c) and provide a higher level of layout flexibility. Context information can be used in the layout definition rules and it enables the processing of elements only if they appear in a predefined context (e.g., if they have a certain parent element, if they have an attribute with a given value etc.). XSL style sheets can also be used to add static content, like headers and footers, to the documents. Arbitrary XSL style sheets can be used by MyXML as long as they import the MyXML style sheet. This style sheet defines the processing of the elements of the MyXML namespace.

The MyXML engine is responsible for the dynamic generation of content as well as the automatic creation of *hooks* for the business logic. The engine distinguishes between static and dynamic MyXML documents. A document is considered as being static if all tags from the MyXML namespace can be resolved at compile time. A dynamic document, on the other hand, contains tags which cannot be resolved at compile time (e.g., user defined variables or CGI parameters which have to be provided at runtime). If a tag cannot be resolved during the compilation, the MyXML engine generates source code encapsulating the layout information and the functionality of the dynamic MyXML document. We generate Java classes from dynamic MyXML documents in our reference implementation, but any other language can be supported as well.

The MyXML process starts with a MyXML document as input. Having checked the well-formedness of this document, a pre-processing style sheet is applied to add layout information and/or static content. In the next step, the generated intermediary file is parsed by the MyXML engine and the tags from the MyXML namespace (see Section 'The MyXML Namespace') are resolved. Another XSL transformation can then be applied to the output of the MyXML engine to generate the final (usually HTML) document. This post-processing style sheet can only be applied to static MyXML documents as the MyXML engine generates Java source code for dynamic ones.

We demonstrate the use of the MyXML system with the example of a search form that lets you search for musicals in the Vienna International Festival web site. All musicals containing a certain keyword are retrieved from the database and are displayed in a dynamic web page in a given layout. The keyword is transmitted as a CGI parameter and is processed by the servlet which is generated by the MyXML template engine. (Fig. 1) shows the MyXML code that implements this functionality.

```
<?xml version="1.0"?>
<!DOCTYPE VIF>
<VIF xmlns:myxml="../ns/myxml">
  <query>
    <myxml:sql>
      <myxml:dbcommand>SELECT * FROM VIF_EVENTS WHERE title LIKE
        <myxml:cgi>musical_title</myxml:cgi>
      </myxml:dbcommand>
      <db_titel><myxml:dbitem>title</myxml:dbitem></db_titel>
    </myxml:sql>
  </query>
</VIF>
```

Figure 1: Example MyXML file to search in a database

Note that there is a strict separation of data and layout as only the content and its structure are defined in the MyXML document. This example demonstrates the use of CGI parameters and the handling of SQL queries. The CGI parameter is used to construct the query string and after the query is executed, the title field is extracted from the result set. In the next step, an XSL style sheet is used for adding a simple layout to the data. The search result is displayed in a table. (Fig. 2) shows the XSL style sheet used for formatting the output.

```
<?xml version="1.0"?>
<xsl:style sheet version="1.0"
  xmlns:xsl=".../Transform"
  xmlns:myxml=".../ns/myxml">
  <xsl:import href="myxml.xsl"/>
  <xsl:output method="html" indent="yes"/>

  <xsl:template match="query">
  <html><h2>The result of your search is:</h2>
    <table><xsl:apply-templates/></table>
  </html>
  </xsl:template>

  <xsl:template match="db_titel">
    <tr><td><xsl:apply-templates/></td></tr>
  </xsl:template>
</xsl:style sheet>
```

Figure 2: XSL style sheet for formatting the output

The style sheet generates HTML output and adds a heading to the document. For every record in the query's result set, a new row is added to the table. In real-world style sheets, more complex rules would be applied to create a more sophisticated layout and element matching. The MyXML engine parses the resulting file in the last step, classifies the document as being dynamic since the CGI parameter cannot be resolved at compile time and, thus, generates Java source code from it. The code generated for the presented example is shown in (Fig. 3).

```
public class VIF {
  protected HttpServletRequest request = null;
  protected ResultSet SQL0 = null;

  public VIF(HttpServletRequest request) {
    this.request = request; }

  protected String getCGIParameter(String paramName) {
    return request.getParameter(paramName); }

  protected ResultSet processSQLStatement(String select, String user,
      String pwd, String url, String driver) {
      // do sql query using JDBC here! }

  public void printHTML(PrintWriter pw) {
    pw.println("<html> <h2> The result of your search is: </h2> <table>");
    printHTMLSQL0(pw); pw.println("  </table> </html>");
  }

  public void printHTMLSQL0(PrintWriter pw) {
    try { SQL0 = processSQLStatement("SELECT title, isbn_nr FROM
          VIF_EVENTS WHERE title LIKE "+getCGIParameter("musical_title")+
          ";", "user", "pwd", "connect", "dbdriver");
      while (SQL0.next()) {
        pw.println("  <tr> <td>"+SQL0.getString("title")+"</td> </tr>");
      }
    } catch (SQLException se) {// ignore exception and continue operation }
  }
}
```

Figure 3: Generated Java Source Code

All that the servlet responsible for the business logic of the website has to do now, is to create a new instance of this class and to call its *printHTML()* method. The advantage of this solution is that a modification of the layout, the data structure or the business logic does not force a modification of the other components. Once the layout has been changed, the VIF Java class only has to be regenerated again using the MyXML engine. We presented a simple example using several elements defined in the MyXML namespace. The next section describes the complete set of elements in the MyXML namespace and discusses their usage.

The MyXML Namespace

The MyXML namespace defines all elements which provide template functionality for MyXML documents. A complete discussion of each element is beyond the scope of this paper. We give a general overview of the elements in the MyXML namespace. A detailed description of the MyXML namespace and example code can be found in (Kerer & Kirda 2000).

The **<myxml:single>** element describes a single variable which can be used arbitrary times in a MyXML document. The value of a *single* element is determined at runtime and the same value is used whenever the element appears. A possible use of the *single* element would be to print a customized welcome text depending on who (e.g., members vs. guests) is currently logged in.

The **<myxml:cgi>** element supports direct access to CGI parameters within a MyXML document. The name of the *cgi* element has to correspond to the name of the CGI parameter it refers to (e.g., the name of the input field in an HTML form). In the above example, we used the *cgi* element to define a database query based on the user input.

The **<myxml:loop>** and **<myxml:multiple>** elements provide iteration and array variable functionality. For all values provided as input for the *multiple* element, the part of the document enclosed in the loop element is processed. The representation of a user's shopping cart is a perfect example for the use of the *loop* and *multiple* elements. Loops can be cascaded. Thus, loops within other loops can be used, for example, to print a table containing all the books in a bookstore along with a list of authors for each book. *single* and *cgi* elements can be used withing the *loop* element for defining functionality and templates.

The **<myxml:attribute>** element is used for dynamically defining an attribute of the parent element which is not in the MyXML namespace. For instance, the *href* atribute of an HTML *<IMG>* tag could be dynamically defined using an element of this type.

The **<myxml:sql>** element represents a database query. It is very similar to the *loop* element. The document fragment enclosed by the *sql* element is processed for every record in the query's result set. Access to database fields is provided by the **<myxml:dbitem>** element. The query to be executed is defined by the **<myxml:dbcommand>** element and can contain other MyXML elements from the MyXML namespace like variables or CGI parameters. Additional elements include the **<myxml:dbconnect>** and **<myxml:dbdriver>** elements which can be used for defining database specific information such as the login and driver information for an ODBC DBMS. The *sql* element can be used for generating XML from a relational DBMS.

Related Work

We have identified several similar approaches and concepts. Template based web engineering tools are not new and there are several popular tools in the market. Most of these technologies are not XML aware but HTML-oriented. Their architectures and generation capabilities have been designed for HTML and do not take advantage of XML.

ColdFusion (Allair 2000) and Webmacro (WebMacro 2000), for example, provide custom scripting languages to embed dynamically generated content into web pages and allow the user to define page templates. The templates, however, are based on HTML and suffer from the flexibility problems we have mentioned. There is no logic and content separation.

HTML++ (Barta 1995) and Jessica (Schranz 1998, Schranz 1998a) are tools which use an object-oriented approach for web site development. They define *classes* and *objects* which provide the content for the template. Source code generation in Perl is provided for CGI scripts but the layout and content information is coded together in an HTML-like language.

The Cocoon project (Mazzocchi 2000) tackles the content and layout separation problem in web sites by using a servlet engine for the real-time application of XSL style sheets to XML files. The Cocoon project proposes two technologies for providing flexible and layout independent dynamic content in web pages; XSP (eXtensible Server Pages) and DCP (Dynamic Content Processor). XSP is completely based on XML/XSL technology and uses XSL tag libraries and associated code generation style sheets (logic sheets) to generate compileable source code. We, in comparison, provide hooks for the business logic so the dynamic content generation does not have be defined in a logic sheet but can be developed independently of the XML/XSL technology. DCP uses a simpler approach than XSP but is an interpreted language and thus, has a performance drawback. DCP is intended to support only dynamic content whereas our system supports the generation of both dynamic and static documents. While DCP is intended to be an easy to use dynamic content generator, XSP has a better performance than DCP since no interpretation is required and compiled pages are cached by the system.

MyXML in comparison to XSP and DCP aims not only at separating logic from content, but also at supporting web sites backed by DBMSs and automating the implementation of frequently needed functionality. MyXML is intended to be simple enough to use and learn but to be powerful enough to provide support for CGI and SQL.

Summary and Future Work

The MyXML system provides a flexible and easily maintainable framework for web site development based on the XML and XSL technologies. The integration of these technologies enables a strict separation between content, layout and business logic. The MyXML namespace provides template elements which support the dynamic generation of content at runtime. CGI parameters and database access support is provided by the MyXML engine. No source code is included in MyXML documents as opposed to many popular web tools. The MyXML engine processes MyXML documents and can either generate a static result document or a piece of source code in an arbitrary programming language.

A common layout can easily be applied to both static and dynamic web pages. We currently use Java in our reference implementation as the output language. The integration of other languages such as Perl or PHP are possible.

Although many web template based tools exist, to our knowledge, only XSP/DCP currently support this clear separation. Layout and content are often tightly coupled together in most popular web tools. Our contribution is a tool that facilitates web site development and maintenance. It provides support for the rapid development of flexible and layout independent web sites by clearly separating the content from the logic.

One of our next goals is to support another programming language besides Java. We are currently evaluating the MyXML template engine in two web engineering projects involving large sets of static and dynamic information. We plan to integrate XML schemas (W3C 2000d) instead of (or in addition to) DTDs in the future. Besides support for XSL transformations, we are also planning to integrate XSL formatting objects into the MyXML template engine.

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Mobile Distributed Telemedical Care System on top CORBA and Cellular Radio Network

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Abstract: A mobile distributed care system is developed for support of patients with brain disturbances and tested in the daycare clinic for cognitive neurology at Leipzig University. The system is based in the wired network on a platform independent implementation using object-oriented architecture, Corba/Java and Internet/Web based technologies, e.g. control and data structures (WML, MML) and protocol stack (HTTP, MTP, TCP, IP). The mobile device, a special palmtop-size computer with touch screen, is connected bidirectionally with the base station via cellular radio network (e.g. ETSI/GSM). To allow disabled persons the use of the mobile device, a patient suitable interface with an integrated voice emergency call is developed. In the contribution the functionality as well as the application conditions in the practical care of patients are represented.

Keywords: mobile distributed computing, CORBA, IIOP, WWW application, cellular radio network, bidirectional pager, neuropsychology, telemedicine, telerehabilitation

1 Introduction

Memory disturbances are a frequent outcome of brain damages. Maintenance or enhancement of the patients life quality often requires an enormous effort of caregivers or family members. Modern information technologies offer efficient conditions in medicine and neuropsychology combining communication techniques with psychological methods. The use of bidirectional pagers enables the therapist to supervise and manage the actions of brain damaged persons even outside the clinical setting thereby being assisted by the patients family members.

The distributed care system is based on Corba/Java, which uses mobile palmtop-size computers to support head injured persons in solving real life tasks, by reminding them of essential facts and dates. About the IIOP interface (Internet Inter-ORB Protocol) the services of WWW can be used. It is one of the first time in clinical neuropsychology, that a bidirectional communication with mobile patient devices via radio connections is used. So it is possible, to observe the patients actions and to react immediately. Experiments with commercial uni-directional pagers showed, that the use of paging devices for telerehabilitation purposes is suggestive, but the backward channel to receive confirmations about the patient actions is necessary for professional treatment of memory disturbed persons (see Cole 1999 & Kopp et al. 1999).

The object-oriented architecture of the proposed care system allows the realization of an extensible, scalable and fault tolerant system. Using generic control and data structures ensures, that the system is applicable to a broad class of operation scenarios without any adaptions at source code level. Corba as middleware platform guarantees efficient software development on heterogenous hard/software without using proprietary software and allows an easy extension of the system by adding new server objects or user interfaces for different therapists as well as for family members, which can support the patient. The patients are equiped with a specific palmtop-size computer. Because of energy reasons the palmtop is connected only some minutes a day with the care system. The other time it has to work disconnected but can always call the base system every time in case of emergency. The user interface is adapted to the patients restricted abilities.
For the wireless connection between the mobile device and the care station in the fixed network serves a cellular radio network, in our case based on the standard GSM (Global System for Mobile Communications), standardized by ETSI (European Telecommunications Standardization Institute). On this communication bearers the well-known Internet/WWW protocol stack PPP, IP, TCP, HTTP is applied. For the mobile access, a data structure like WML (Wireless Markup Language) is used, which allows also the mobile access to the Internet

and via IIOP to the Corba-based care region. For realization of the functions a special script oriented specification language MML (Mobtel Markup Language) and an appropriate transfer protocol MTP (Mobtel Transfer Protocol) are developed, both analogous to WML resp. HTTP in the Web architecture (see Fig. 1).

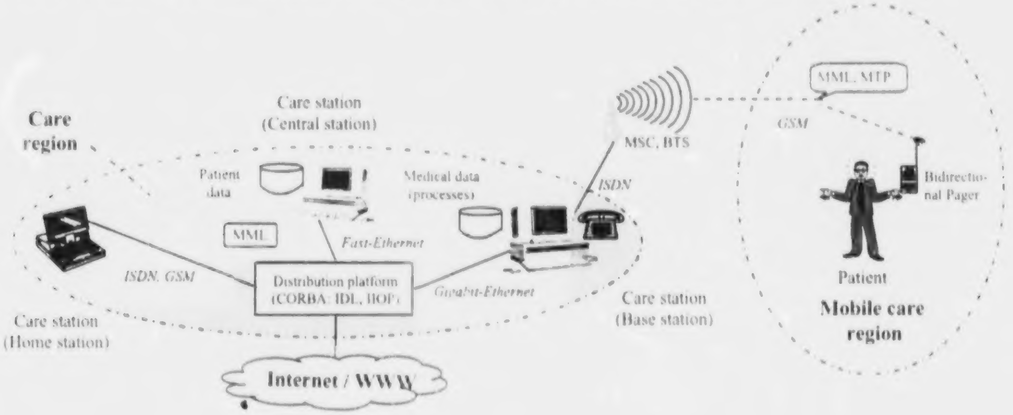

Fig. 1: Distributed telemedical care system with mobile equipments (bidirectional pager)

The implementation follows by an interdisciplinary project, called Mobtel, in co-operation with different partners at Leipzig University (Chair of Computer Networks and Distributed Systems and the Daycare Clinic for cognitive Neurology) together with Max-Planck-Institute of Neuropsychological Research at Leipzig and RBM electronic-automation GmbH Leipzig (see Irmscher et al. 1999).

2 Architecture

2.1 Requirements of a Mobile Care System

Memory disturbances are besides attention deficits one of the most common sequels of brain damages. To compensate these deficits external memory aids like calendars or memory books have been used. However, the use of external aids has often failed due to several difficulties inherent in patients functional deficits. Modern electronic timer or organizers on the other hand are too complex in design and handling, so the patients are not able to learn the use of such an external device. Therefore, there is a strong need for an interactive external memory aid. The proposed care system enables the caregiver to survey the activities of a patient. The patient also has the opportunity to call for help whenever he doesn't succeed in managing a situation on his own. This bidirectional data exchange is basis of the relative young research area of telerehabilitation (Rosen 1999).

Main focus is the development of a distributed heterogenous system which considers especially the needs of the brain disturbed patients, the unreliability of mobile communication, the limited resources of the mobile device and a heterogenous care region. Furthermore, the base system provides the basic services in the fixed network, which can handle the unreliable connections to the palmtop, which is extensible to new neuropsychological methods, scalable and fault tolerant. With the Corba architecture the possibilities are given for heterogeneous systems as well as the connection to Internet and Web services using the IIOP (Internet Inter-ORB Protocol) facility.

The interactive care of brain injured patients requires an online connection between caregiver and patient by mobile communication and therapy services. The WML-like data structure MML serves for mobile access to the care services, prepared automatically by the care station in the fixed network (taskplans). This architecture also can used for mobile access to further services on special Web servers, similar to WAP technologies decribed by WAP forum (Wireless Application Protocols).

2.2 System Overview

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The major requirement we had to consider during the development of the architecture was the bidirectional communication between the therapist and the patient using mobile telephone technologies. By reason of the unreliability of mobile communication, this has two consequences. The mobile patient device has to work independently from the base system, and the base system needs a pager proxy object (pager object) for every pager, which stores all necessary information for the pager. During every communication, the pager object reads the logfile of the pager and updates its internal state.

For disposal of Internet contents on mobile platforms the language standards WML (Wireless Markup Language) and HDML (Handheld Device Markup Language) are developed. Both are action- and event-oriented structured and matched to HTML (HyperText Markup Language). WML is a tag-based document language, defined with XML (eXtended Markup Language) and considers the device resources are limited (diplay size, storage, power). A HTML page in WML is called a "card". Near by can be distingushed into display cards (for notice), choice cards (for choice) and entry cards (for input, generally text oriented). Several cards within a WML document are collected as a "deck" and transmitted summarized. The in WML formated documents are kept on corresponding servers and can be transmitted via an air interface to the user agent (browser) on the mobile end device and there displayed with a micro- or WML-browser.

Since existing markup and scripting languages like HTML/JavaScript or WML (Wireless Markup Language) are not applicable to our system, because they are either too complex or too simple, we developed a special markup language (MML - Mobtel Markup Language), which enables a partial autonomy for the pager, but is not too complex for mobile bandwidths, and a simple transfer protocol (MTP - Mobtel Transfer Protocol) on top of TCP, which considers the special features of the proposed architecture.

Analogous to WML a set of linked cards is called a deck. Every task a patient has to solve consists of one or more decks. At the mobile level the pager only knows decks and cards, but on the base system and user interface level we only consider tasks. The data structure for tasks forms a graph (taskplan). For every activated task a proxy task object is created, which manages the creation of the corresponding MML-description, the transmission to the palmtop and supervises the status of the task on the palmtop by analyzing the pager logfiles. If a critical state is reached, the pager object sends a message to the caregiver, using SMS (Short Messaging Service), email or a simple pop-up window.

2.3 The Mobile Device

The pager should be usable for patients with cognitive deficits, so it must be fault tolerant and very easy to handle. The ergonomic design is very simple, we only have two hardware buttons. All other interactions are performed using the touchscreen. With the GSM module a voice or data connection can be established. The voice connection is used for emergency calls to the therapist or to make appointments with a caregiver. The data connection is used to send new tasks to the pager, to update or delete tasks and to receive logfiles from the pager.

A major problem in the development of the patient palmtop is the standby time of the device. If the base system requests a communication to the palmtop, a message will be sent using the Short Message Service (SMS) of the cellular radio network. If a SMS message arrives requesting a connection or other reasons for connecting the base system, the palmtop connects to the base system and establishes a TCP/IP connection using PPP (see Black 1995 & Walke 1998). The functions and protocols used are supported by the operating system Windows CE for the interactive pager device.

2.4 The Base System and Graphical Interface

For realization of the main functions the distribution platform Corba as middleware and Java as programming language are chosen. So, the base system can be described as a set of Corba objects distributed to several computers. To store data an object-oriented database is used, which works together with the persistence facilities of Corba [Orf97]. Additionally, Corba secures with the IIOP interface (integrated in ORB kernel) the connection to Internet services. The Corba architecture used in the system is shown in Fig. 2.

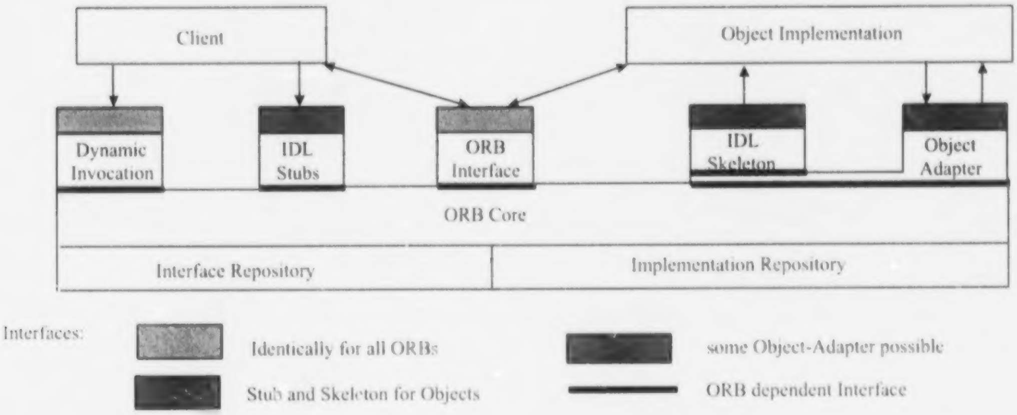

Fig. 2: CORBA (Common Object Request Broker Architecture), Components and Interfaces

The connection to the mobile patient devices are established by a special server (pager gateway). This gateway is a Corba object for the base system as well as a socked based server for the palmtop. If the palmtop connects to the gateway it asks the gateway for a list of new or updated decks and loads down all MML files for these decks. Such MML files can be stored by the pager gateway or they are created dynamically. Therefore the gateway connects the corresponding pager proxy object.

The user interfaces are designed as thin clients. This approach has several advantages. The business logic is implemented only once a time. Adaptions can be done without changing the user interfaces. The user interfaces are implemented as Java objects and connect the base system using its Corba interfaces, other user interface types as Java applets or a Web interface using servlets, Java server pages or CGI scripts (Common Gateway Interface) easily can be implemented. In further steps also the mobile access to Web-based services via portals will be taken into account.

3 Realization of the Base System

3.1 The Distributed Model

For implementation of the base system each real world entity (e.g. patients, mobile devices, tasks) is represented by a proxy object. These objects are Corba objects and they communicate with each other using their interfaces. Every object is responsible for its real world entity. Additionally, some management objects and Corba services coordinate and simplify the cooperation of the object world. So, switching between analysis and design in the software development process is quite easy using UML (Unified Modeling Language), and the model can be easily extended or adapted to future requirements. Using a large number of Corba objects, they can be distributed to several computers to spread the work load and increase the throughput of the base system. With the capabilities of the Portable Object Adapter (POA) it is possible to realize a dynamic load balancing over all computers involved (Gamma et al. 1995 & OMG 1998).

3.2 Pager Object and Tasks

Pager Object and tasks are the main components of the architecture. Every pager object is responsible for one mobile patient device and manages the state of this device. The pager object handles every communication with the palmtop. Since the mobile device is mostly disconnected the pager object stores the newest known state of the palmtop. On the other side the pager object manages all assigned tasks. So the pager object recognizes two contradictory tasks and refuses one of them or reorganizes the scheduling of the tasks.

A generic data object and a taskplan object is assigned to every task object. With the data object and taskplan the task object can create the MML description of itself. The MML description of the task will be commited to the pager object and registered at the pager gateway. If a mobile device connects to the pager gateway, the pager gateway requests all registered MML files from the pager object and transmit them to the palmtop.

At the beginning of every communication between the pager gateway and the mobile device the logfile of the palmtop is transmitted. The logfile entries are evaluated by the pager object, which transmits them to the corresponding task object. Here the task object updates its state. If a task is in a critical state, a message will be sent to the therapist.

3.3 Co-operation of the Server Objects

A typical scenario for the use of the base system could be the creation of a new task for a patient. The therapist will use the therapist interface and selects a taskplan in a list of available taskplans for the patient. The taskmanager creates a new instance of a task object. The task object attaches the taskplan and creates a data object. With the information stored in the taskplan the task can be adapted individually by the therapist to the patients needs.
The edited data are stored in the data object. The MML description of the task can be created with the data of the data object and the taskplan. Additionally, the task calculates the time the patient needs for it and tries to reserve this time at the pager. In this way a caregiver for the patient knows about the patient schedule and if two tasks collide the second task has to start at anothcr time. If a task is registered at the pager object, the pager object informs the gateway about the new available task. During the next communication between the patients palmtop and the base system, the gateway requests the MML description from the pager object. The pager object asks the task object, and the task object creates the necessary files, which are uploaded to the patient device.

3.4 Technical Issues

Although the system works on a single computer, experiments have shown, that the base system is more efficent, it is implemented on more than one computers. The first is the pager gateway (Linux server), which manages the telephone connections. Linux supports currently up to 4 ISDN cards in one computer, using the AVM C4 ISDN card with 4 base connections on every card, we can support 32 connections at time.
For stability and performance reasons the database should run exclusive on a server, connected by a fast network. To use the Corba persistence capabilities, POET is used, a object oriented database for Java 6.0. A further computer is employed as server for the base system core. Depending from the number of patients the Corba objects could be distributed to a computer cluster. Since using Java 1.2 and Corba, we are independent from a special operating system and can support Linux, Windows and Solaris.

4 Telemedicine - Use in Neuropsychological Therapy of Patients with Memory Disturbance

The prototypically developed mobile and distributed care system is evaluated at the daycare clinic for cognitive neurology at Leipzig University. Trial persons are equiped with the bidirectional palmtop-size equipment. The base system is located in the clinic and connected with the mobile devices by ISDN (Integrated Services Digital Networks) and radio telephone connections using the ISDN/GSM gateway of a telephone provider. The stationary care system in the clinic can be extended with further care stations (e.g. home station) about the Corba bus. Therefore, the additional care stations have to establish an ordinary Internet connection.

The treatment methods for patients are the content of taskplans, realized by tasks of the base station. A typical task is the reminder to take up a certain medicine, for example. Medicine used in the treatment of brain injured persons often has to be taken up in very strict intervals. If the patient forgets to take up this medicine the success of the therapy might be critical. Moreover, for the caregiver it is necessary to get a feedback about success or failure of the actual action. By combination of different cards activities can be realized, described in the taskplans. A typical example is shown in Fig. 3.

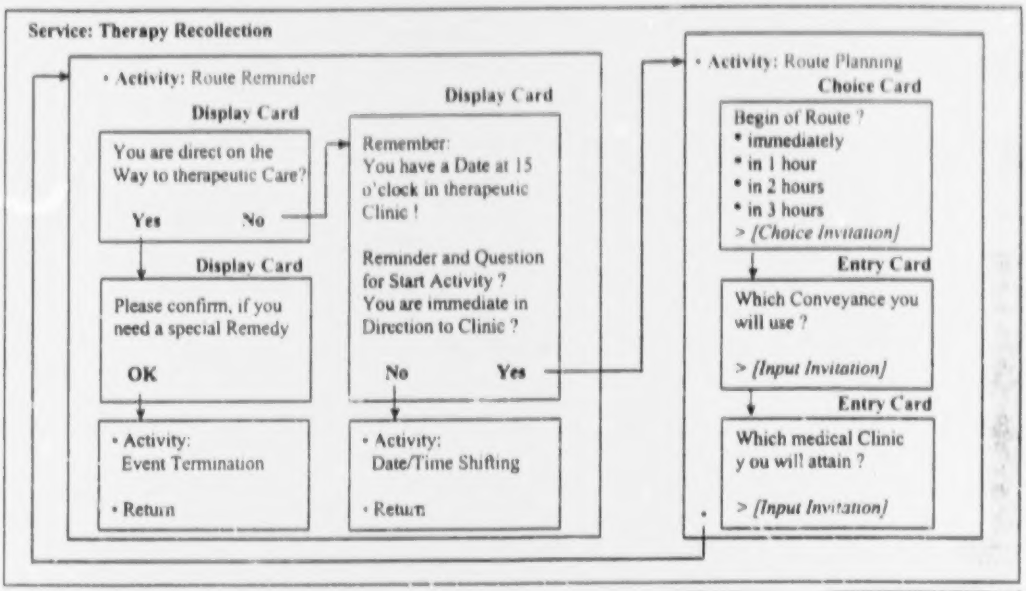
Service: Therapy Recollection
• Activity: Route Reminder
Display Card
You are direct on the Way to therapeutic Care?
Yes
No
Display Card
Remember: You have a Date at 15 o'clock in therapeutic Clinic !
Reminder and Question for Start Activity ? You are immediate in Direction to Clinic ?
No
Yes
Display Card
Please confirm, if you need a special Remedy
OK
• Activity: Event Termination
• Return
• Activity: Date/Time Shifting
• Return
• Activity: Route Planning
Choice Card
Begin of Route ?
• immediately
• in 1 hour
• in 2 hours
• in 3 hours
> [Choice Invitation]
Entry Card
Which Conveyance you will use ?
> [Input Invitation]
Entry Card
Which medical Clinic y ou will attain ?
> [Input Invitation]

Fig. 3: Taskplan for recollection of different patient activities

A more complex task is to lead the patient to a meeting using public transport with a change in between. Such a task starts with a pre-alarm, informing the patient, that he has to prepare mentally and practically for the actual job. When the patient has to leave home, the palmtop will remind him of taking needed things with him, like the keys or money. While it is not important to confirm the pre-alarm, the final alarm with the reminders has to be confirmed. A real critical situation is the moment of changing the tram or the bus because there are a lot of possibilities to fail and the correct state of the patient cannot be tracked in every case. It is impossible to consider all possibilities of such a complex task. Therefore it is important to test which class of brain injured patients can complete such a difficult task.

For evaluation the care region at first within the department of medicine and the base station in the daycare clinic for cognitive neurology are installed and selected patients are equiped with mobile interactive pagers. First experiments show good results by use of of the intelligent equipments. Statistical secured results of validity of the complete care system will be available at the end of the neurological test phase. Besides the functional tests of the care system, new therapy methods are developed to prove it with the care system. Furthermore, the acceptance of the system and especially of the mobile device is tested at patient classes with different mental disturbances. Generally, new scenarios for use in telerehabilitation are investigated and developed.

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Content Management in Web Based Education

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Abstract: Based on the newest information and communication technology all the needs of modern educational systems can be met for the first time in one tool and one medium: the computer and the internet. Computer based solutions provide the technological support necessary for the whole teaching and learning process. The greatest advantage is the possible combination of all usable instruments, their flexibility and configurability. With new technologies and new media types it will be possible to support all kinds of training, self-study and continuing education in local or global networks over the web. It is clear that these new methods and technologies require new methods and solutions for the tasks content creation, delivery and archiving in education. Especially the use of new media sets high requirements on these tasks. This article describes how content management systems, a technology already used in other kinds of business, can support these tasks in web based education. After an introduction a definition of content management is given and refined for the area of web based education. Next the main building blocks and features of content management systems are described and the improvements for web based education are highlighted. Finally content management is embedded in the learning workflow.

Introduction

New media in education is becoming increasingly necessary in making the change to an information society. However, education is expensive and has to be performed efficiently. Educational institutions therefore have to implement new and more efficient teaching and learning environments. More powerful learning systems are required. Learning in the next decade will become a distributed process, not only restricted to classrooms and lecture halls. The use of learning proposals offered over the internet and the world wide web will increase, because the internet and the world wide web offer a standard technological basis for transferring information. This technological basis is affordable and accessible for everyone.

Modern web based teaching and learning systems not only present knowledge and information in words and pictures. They include simulations and animations and offer individually designed and interactive learning. New multimedia technology in conjunction with the use of the world wide web are an ideal basis for reforming and modernizing education.

As web based education offers become increasingly available, the amount of online learning material will increase consequently more and more. New learning material will be build up more and more of multimedia and hypermedia content for easier illustration and imparting knowledge (see [1] and [2]). With the focus on multimedia and hypermedia, the growing amount of learning content therefore has to be managed to reach the following basic goals:

- To manage a large amount of interactive multimedia and hypermedia learning material
- To keep the overview about the whole content used in learning programs
- To store and archive learning content with a centralized access
- To preserve physical quality of the learning content
- To make the learning content reusable for further processing in new learning content creation
- To provide functions for searching, content browsing at the site of the learner over the world wide web
- To allow retrieval and delivery directly to the learner over the world wide web

These main goals are grouped by IBM into the following categories (see IRT Seminar [19]), where efficiency and effectiveness of current solutions can be improved:

- Storage of digital media
- Access to stored media
- Management of media assets
- Production process

Especially the last two basic goals have to be realized by functionalities directly accessible by learners and therefore have to be realized in a user friendly and time and location independent way, e.g. by WWW interfaces. The reuse of learning content for the creation of new learning material will normally be a feature for the authors of new learning lesson who additionally are interested in searching, browsing and retrieval functions for research and lookup. The other goals are typically reached by implementing backend server applications like storage management systems, fulltext retrieval engines or database systems with appropriate data models, data and essence management and user interfaces for system administrators.

This article describes in the following sections how Content Management Systems, a technology already used in other kinds of business like television broadcasting (see [3] and [4]), can support important tasks in web based education to reach the goals described above. An informal definition of Content Management is given and refined for the area of web based education. The main building blocks and features of Content Management Systems are described and the improvements for web based education are highlighted. Finally Content Management is embedded in the learning workflow.

What is Content Management

Ever since images and sound are available in digital format – and thus as data – it has become common use to distinguish between media data – image and sound data – and metadata describing the actual media. Metadata are for example information about the title of a learning theme, its length and its content. According to a standardization suggestion by the Society of Motion Pictures and Television Engineers [5], image and sound data are called **Essence**, while all descriptive data is being called **Metadata**. "Meta" in this context means as much as "about" – indicating that Metadata contains information *about* media data. How Metadata can look like, is described for example in [6]. Essence and metadata together are summarized under the collective term of **Content**.

How does this content look like in web based education? Here we deal with texts, pictures and graphics, with hypertexts, multimedia and hypermedia but also with active objects like applets, servlets and scripts because learning mostly is still an interactive process. These active objects can be summarized as Active Learning Media Objects. All these objects, media types and their combination can be summarized in the term Essence, while all descriptive and administrative data about essence and it's sequencing accordingly are the Metadata.

Typically the metadata is carried together with the essence to provide easier searching and access to the essence objects. Especially in the case of Active Learning Media Objects or multimedia objects, these objects are coded in a way which is not indexable or searchable in an easy way. Often there are logical connections between the essence and the metadata. For example, an abstract may relate to a particular time span in a video material, and a usage restriction will usually also apply to a particular time span in a video material.

Content Management Systems

The basic features of Content Management in web based education can be grouped into the following building blocks:

- *Creation*: The complete process of authoring and production of Content. This includes typing, drawing, painting, recording, digitization, encoding and storage of essence and metadata.
- *Registration*: Importing content in a web based learning system. This can be an automatic or manual import. By registering, content gets known to the Content Management system, unique identifiers will be associated and automatic processes for classification and indexing of the content get started.
- *Classification*: All kinds of intellectual or automatic analysis and classification of imported content. The intellectual analysis and classification can be supported by appropriate representation forms and documentation tools. The automatic analysis and classification can be supported by methods of cut recognition, key frame extraction, audio classification, speech recognition, face recognition and other kinds of analysis methods suitable for metadata creation. Classification can also be performed manually by adequate tools for documentation and arrangement.
- *Search*: Searching for content either by metadata, which is linked to the essence, or directly by the essence. Typically full text search or similarity search are the commonly used methods. Content based search can be enhanced by filtering, personification, interpretation or methods of case based reasoning.
- *Retrieval*: Retrieval of found content by transfer, play, browsing, streaming, display, distribution, download, export or connection.
- *Modification*: Changing of essence or metadata with modification and documentation tools. These tools are typically the same tools as used for classification.
- *Storage Management*: Content preserving and archiving in file systems, HSM systems or archives, repositories and databases, automatic or manual format conversion for retrieval through different connections, i.e. different bandwidths in networks.
- *Workflow management*: Methods for combining and sequencing the basic functional and management features in a learning workflow.
- *Additional blocks* for special usage areas: Additional functions in some usage areas like rights management, e-commerce and billing & accounting which affect all building blocks above. This can also be the connection of external devices for audio and video or the connection of legacy systems.

Thus the term **Content Management System** can be defined as a *software system which provides functions and tools for the tasks and functions on essence and metadata* as described above. In web based learning the essence consists of the learning material in different variations, i.e. hypertext, multimedia, hypermedia, text, graphics, pictures but also active components, the Active Learning Media Objects. The metadata is the associated descriptive data related to the essence.

How can Content Management improve Learning

As we can see in the listing of the tasks and functions for Content Management above, the tasks and functions represent important, but not all parts in learning workflow. As a consequence the main goal for an integrated Content Management in learning will be the support of all these tasks and functions in combination and sequence for an appropriate representation of learning workflows.

According to a summary generated from the Bertelsmann Foundation [7], this leads to an improvement of learning in the following areas:

Technological ergonomics:

- Active Learning Media Objects allow for practicing by simulating. They additionally realize active objects within the learning workflow, which can interact with the learner and show a certain kind of behavior/intelligence if they follow the agent paradigm.

- Quick referencing, backtracking, easy lookup in referenced material is possible by an integrated storage management with a central repository, in which all learning objects are located.

Preparation of learning material:

- The usage of new media types, i.e. hypertext, multimedia or hypermedia, permits for the building of complex knowledge constructs, in which the learner can navigate guided by a predefined learning strategy in the workflow management.
- The learning material can be enhanced by cooperative learning tools with team oriented groupwork and integrated communication facilities. Learning material can additionally be enhanced by active or interactive coaching tools.

Use of new media:

A greater variety of content representation is possible by the use of hypertext, multimedia, hypermedia or streaming technologies, such as:

- Audio, Speech, Video, Animation, Simulation, Business-TV, Broadcasting
- Pictures, Graphics, Photographic Images, Figures, Texts, Hypertexts
- Combination of all types listed above in multimedia or hypermedia objects

Communication and interactivity:

- Interactivity between participants and interactivity with the learning material is supported
- Synchronous and asynchronous communication forms are supported
- Interactive media types and interactive evaluation types are supported

Embedding of Content Management in the learning workflow

Which enhancements do Content Management Systems offer for web based learning?

First of all, the heavy use of multimedia and hypermedia material in learning demands for better retrieval and browsing techniques to select the right material out of a vast amount. Content Management Systems provide experienced techniques in dealing with new media types embedded in web structures. They offer browsing features with streaming techniques for multimedia/hypermedia objects (MPEG-1 [8], MPEG-4 [9] or RealAudio/RealVideo [10]) together with the connection to extended learning objects, in which additional information about these multimedia/hypermedia object is stored. This additional information can be the same multimedia/hypermedia objects in other resolutions and bandwidths for different networking connections, streaming or download. Content descriptions can be stored together with the multimedia/hypermedia objects (MPEG-7 [11], Learning Objects Metadata [12]) and be helpful in search and retrieval.

Furthermore Content Management Systems provide techniques for modeling different learning workflows if they include workflow management support. Different learning workflows result in different design perspectives, which end in different workflow implementations. The different workflow implementations could lead probably to different implementations of the tasks and functions or the use of different components of the Content Management System. A large amount of different design perspectives, called stakeholder perspectives, is listed and mapped to the general framework of the Learning Technology Systems Architecture (LTSA [12]), developed by the IEEE Learning Technology Standards Committee (LTSC). As is stated in LTSA, the differing and sometimes conflicting design priorities can make standards setting difficult. Architectures like LTSA can help resolve that conflict. By embedding a LTSA compliant Content Management System for the realization of a certain group of stakeholder perspectives, the step from abstraction to implementation can be made by providing a common platform for the design and implementation.

However, some questions arise, when trying to go this step:

- The support variety of new media types, especially Active Learning Media Objects, is a non trivial question, especially when designed for web based use.
- Standards for learning material and essence description are missing up to now. Some efforts for parts of learning material are made in MPEG-4, MPEG-7 and Learning Objects Metadata. The MPEG-4 standard concentrates on an object based representation of the essence of multimedia by identifying "media objects" and defining their composition, multiplex and synchronization, while the MPEG-7 standard concentrates on descriptions for multimedia content. Learning Object Metadata concentrates on relevant properties of learning objects by the definition of a metadata structure for management, location and evaluation. All of these standards deal with important aspects of a coming standard for web based multimedia and hypermedia learning material.
- Complete standards for teaching and learning environments are missing up to now. LTSA tries to make an descriptive proposal for such a reference architecture, on which concrete system definitions or architectures can base on or be compared with.

Conclusion

Content Management can be the center of a complete educational environment in the WWW, which provides basic functional and management features together with workflow support in web based learning. As we have seen above, the tasks and functions of Content Management Systems can improve the access to multimedia and hypermedia content in learning as well as support new learning media types, the Active Media Learning Objects.

Currently there a no Content Management Systems commercially available on the market, which provide a complete integrated web based learning environment. Different systems, which all call themselves Content Management Systems, provide either parts only of the main building blocks required or are designed for the use in special lines of business other than learning. Examples for this are document management systems or database systems, which mainly provide the technological basis in storage and archiving together with query and access functions.

For web based learning, additional features for the implementation of learning strategies and human interactions in learning have to be provided on the basis of Content Management by higher layers like Knowledge Management or Information Management (see [14], [15] and [16]). A complete integrated web based learning environment has to provide functions and features on all layers, Content Management and Knowledge Management and Information Management. A discussion of major issues for workflow and end user quality of service in web based education can be found in [17].

The Content Management system media archive® [18], developed by the tecmath AG for the television broadcasting industry, currently supports all tasks and functions described above for the workflow of audio and video in broadcasting. media archive® is under further development for the employment in web based learning (see L3 [20]). Many features of Content Management, which deal with the tasks of the building blocks described above, can clearly be mapped to computer based education. Especially when using new media types like audio, video or broadcasting, the developments already made in modern digital broadcasting promise good results for the support of educational environments.

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What=s Wrong With On-line Discussions
- And How to Fix It –

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Abstract. On-line discussions, whether for distance education or business purposes, are a normal component of Internet activities. Yet, such discussions often fail to achieve desired objectives. Herein, we describe 11 common problems with on-line discussions and present ways to avoid or fix the problems. The casual use of on-line discussions can be enriched and extended by collaborative and constructivist practices in an appropriate software environment.

On-line discussions can be like a party that nobody comes to ... or a party where people are dressed wrong ... or a party where they bring the wrong kind of presents ... or a party where a drunk spoils it all with his boorish behavior. But on-line discussions are accepted as normal components of Internet activities. In distance education, for example, on-line chats and asynchronous e-mail discussions are a standard part of many on-line courses, and increasingly serve as a complement to resident instruction (Klemm, 2000). In the business world, executives and workers conduct on-line discussions and meetings to save travel costs, cope with schedule and time zone conflicts, and develop and document corporate memory of ideas, plans, and projects.

However, such discussions often fail to achieve desired objectives. The purpose of this paper is to summarize what I have seen go wrong in my six years of participation in on-line discussions and to recommend some remedies that I and others have found. The emphasis is on helping discussion leaders to structure and guide on-line discussions for maximum effectiveness. The paper has a focus on learning environments, which are central to both formal academic training and to corporate training of personnel, but the principal findings apply also to corporate environments.

Why On-line Discussions Are Important

I will specify later how such discussions are commonly flawed, but first I need to affirm why they are important and why group leaders should try to perfect the way that discussions are managed. The advantages of well-run on-line discussions (Knowlton et al. 2000) include:

- Participants don=t feel so isolated
- Participants can build relationships
- Everyone has a chance to be heard
- Interactions with others can be motivating and instructive
- Discussions can provide broader perspective and new insights
- Views become subject to re-examination
- Ideas and facts can be processed at a deeper and more creative cognitive level

Asynchronous discussions have the additional advantages of:

- Avoiding schedule conflicts and providing convenience
- Providing time for research and reflection
- Organizing data and commentary more effectively

What Is Wrong With Many On-line Discussions

A list of common problems and remedies follows.

Problem	Remedies
1. **Participants don't realize the purpose.** If a discussion does not have obvious goals and requirements, participants tend to think of it as a virtual lounge. Depending on their need for socialization, they may or may not participate extensively. If they do participate, they may spend too much time in trivial chit chat, rather than intense intellectual dialog.	a. State the purpose and objectives explicitly b. Use content-rich topics c. Require group deliverables (plans, projects, reports, case studies, etc.)
2. **Purpose is unclear and expectations are vague.** If a discussion is just a work space for miscellaneous comments, people may not supply much relevant input. Indeed they may not know what relevant input is, because the group leader provided insufficient guidance.	a. Explain the purpose and goals b. Give feedback to serve as model c. Make certain everybody knows that important people are monitoring and evaluating participation
3. **Lurking. Participants just read, but do not contribute.** Some people are shy. Some are insecure. Some are not as well informed as others. But on-line discussion groups can be a great equalizer and can allow the talents and knowledge of everyone to be tapped in ways that never occur in face-to-face meetings.	a. Require input b. Publicly discourage lurking c. Reward input d. Minimize negative feedback e. Build community f. Build teams
4. **A few people dominate all the discussion.** The corollary of lurking is that a discussion becomes dominated by a few people who do all the Atalking.@ People get tired of their constant chatter. These people also tend to get carried away with idle comment.	a. Fix the lurking problem b. Make certain you have a group leader with authority c. Give gentle corrective feedback by private mail d. Post publicly the need to maintain focus, stay on task, and keep message volume down
5. **Comments are trivial.** Comments are weak, irrelevant, or off task	a. Discourage it and explain why b. Give examples of trivial input c. Have specific goals and tasks d. Remind people to stay on task e. Model desired behavior and praise others who do
6. **Comments are opinion driven**. Messages are often nothing more than each person=s opinion on a topic. Asking students, for example, to express their opinions, which is all that many teachers do, does little to develop students= knowledge base, not to mention their creative, integrative, and analytical abilities.	a. Insist that opinions be defended b. Create tasks that get beyond opinion
7. **Participants don=t know what good input is.** Many people have no experience with on-line discussions and little way to know what constitutes useful exchange of information.	a. Show by example what good input is b. Praise the good input of others

8. **Nobody reads what is posted**. I remember a presentation at an educational technology meeting where the speaker, a professor, proudly displayed a listing of all the e-mail messages his students had posted. Notably, the messages were all annotated with ANew,@ meaning that he had not read any of them. It is a good bet that the students had not read them either.	a. Create groups b. Use shared workspace, where many messages can be open in one place c. Assign group editor to write summaries
9. **There is no tangible result**. An unfocussed discussion without specific goals and tasks will almost inevitably prove unproductive.	a. Use a constructivist approach that requires participants to generate a product or some kind of deliverable
10. **Too much e-mail**	a. Put the burden of communication on the participants
11. **Wrong software.** The software is too klutzy to do much more than exchange e-mail. Lack of shared workspace is a common limitation of on-line conferencing software. Another problem is outline organization of separate e-mail messages.	a. Don't use software with threaded-topic organizing principle b. Use commercial software that supports shared workspace and hyperlinking as the organizing principle

Many of these solutions derive from two theoretical perspectives: the theories of collaboration constructivism Collaboration builds a sense of community. Ideally, team building occurs. In the business world, team building is a fundamental necessity in many companies. Educators increasingly value the building of learner terams (Berg, 1999).

Collaborative Learning On-line

Collaborative learning (CL) is a learning style in which small student groups work as teams to help each other master academic material (Goodsell, et al., 1992; Johnson and Johnson, 1989; Kaye, 1991). Collaborative learning (CL) approaches give students access to the shared knowledge, experience, and insights of other members of a learning team. CL is effective because it thoroughly engages students in learning activities and leverages the teacher's efforts by involving students in helping each other learn. CL is particularly important for high-order, critical thinking skills that must move beyond the passive memorization of facts to a deeper engagement in which students help each other to comprehend, assess, and apply information in ways that lead to new insights and understanding. CL promotes better thinking skills than competitive or individualistic learning environments (Gabbert et al., 1986).

Teamwork is a central element of this learning style. Effective CL requires that students be positively interdependent on one another (Johnson and Johnson, 1989). Assigning complementary roles to each team member helps assure that learning objectives are understood and appreciated by everyone.

Collaboration is especially needed in on-line learning., because learners tend to be isolated, without the usual social support systems found in on-campus instruction. Distance learners must disciplined and motivated in order to cope with the constraints and limitations of the relatively impersonal instruction that occurs via distance education technologies.

Asynchronous conferencing for on-line CL (Klemm, 1995) directly addresses under-participation. In simple discussions, participants find it easy to become Alurkers@ who may or may not read the messages and who certainly have no compelling need to create messages (Klemm, 1998b).

Some of the things that I have student groups do on-line include solving statistics problems and reaching a group consensus on bioethics problems. The work is made much easier because they are helping each other to understand the problems and the approaches to solution (see www.cvm.tamu.edu/bims470). Another thing I do is have students participate in Ainsight exercises@ in which each student in a learning team asks a creative question about the subject matter (neuroscience) and then provides a rationale and strategy for answering it (Klemm, 1998c). Each student in the group then makes in-context critique comments in a shared document, building up a basis for the group to select the Abest@ question and answer, which they then refine and submit as a group for a group grade. Each group has a group Leader (who assures that things get done on time and that everybody is pulling their share of the load), a Best Q&A Editor (who coordinates the debate and writes the revisions), and two or more Librarians, who do the library work to provide information. They develop a team spirit, actually wanting to compete with the other groups for the best grade. See www.cvm.tamu.edu/vaph451.

The common problems found with group work in on-campus teaching have not occurred in my classes. First, no one can make excuses about schedule conflicts. Secondly, everyone=s work is conspicuously available for inspection by everyone else. Students cannot hide, and they become motivated to display good work to their peers. And finally, I have students rate each other at the end of the course in terms of Ahelping@ behavior. These rankings allow me to give bonus points on the final grade, and students work hard to contribute to the group effort because they want those bonus points).

In the classes where on-line group work complements in-class lectures, groups consistently developed strong supportive bonding, reinforced by the face-to-face activities in class. In an Internet class last Fall when I tried group work, bonding was not evident. I blame this on my failure to set deadlines. I allowed groups to submit their work any time during the semester, and this irritated the more conscientious students because they had to wait on the procrastinators. Next time, I will set deadlines for each of the group projects and create a visibly competitive environment among the teams.

Constructivism

Constructivist theory supports the idea that work or learner teams need to DO something and generate a deliverable. For corporate work groups, this can range from a making a corporate decision to developing plans (such as business plans, or plans for such activities as marketing, new product or service development, acquisitions, and quality control) to assessing the success of the business to personnel training. In a learning environment, I define academic deliverables as student-created products that can take the form of proposals, plans, reports/papers, case studies, debates, ideas from brainstorming, decisions, portfolios, brochures, kiosks, hyperstories, or a variety of special projects (Klemm, 1998a).

An over-simplified definition of constructivism is that it is learning by doing. Constructivism is an approach that has grown from the ideas of Jean Piaget (Watzlawwick, 1984; Formann and Pufall, 1988; Butts and Brown, 1989). Central to constructivist theory is the idea that learning involves active engagement of students in constructing their own knowledge and understanding (Rieber, 1993). Constructivism is learner-centered, rather than teacher centered.

Constructivism has three components: epistemic conflict, self-reflection, and self-regulation (Forman and Pufall, 1988). Epistemic conflict occurs when a problem needs to be solved that is outside a person=s current repertoire. Resolution requires the active engagement of the learner, and is enhanced by joint engagement with other learners. Self-reflection is the learner=s response to conflict. The learner must attempt to identify the problem explicitly and objectively. Self-regulation is the process whereby the learner adjusts and reconstructs thinking to deal with the learning problem at hand.

For example, in my neuroscience course, one student was a very bright electrical engineer with expertise in electronic neural networks. The issues that we raised in our conference required him to re-think the information processing that occurs in electronic networks in the context of how nervous systems process information. He had to Areconstruct@ his knowledge and experience, in the face of conflicting evidence about how computers work and how brains work. His adjustments to these conflicts were reflected in the conference, not only enriching his own understanding of neural networks but also creating whole new dimensions of thought for the more biologically oriented students. The conference made his thinking accessible to the other students in ways that would never occur in a typical lecture class.

A Special Relevance in the Information Age. Although not new, constructivism has more compelling relevance in education today because of the dawn of the Information Age (Duffy and Jonassen, 1992). Such profound changes require us to re-think learning processes and to design instructional tools that equip learners to cope in the Information Age. In most academic fields, it is no longer possible to expect learners to master more than a small sub-set of the total information. *The new requirement is for learners to learn how to find information, understand it, and apply it.* These are constructivist activities. The power of information technologies dictates the implementation of constructivism.

Conferencing Software

In an earlier paper, we elaborated the distinctions between e-mail, bulletin boards, and collaboration software (Klemm and Snell, 1994). Briefly, the distinction is that e-mail and bulletin boards are messaging systems, where notes are mailed from one person to the others or are posted on an electronic bulletin board for others to see. Such communication supports collaboration only in a primitive way. Students cannot directly edit each other's messages. They cannot even refer to each other=s content without cutting and pasting text from the e-mail being referenced. E-mail messages appear chronologically rather than logically. Bulletin boards organize e-mail only by some arbitrary scheme, such as a "threaded" topic outline. Specific places in the outline serve as fixed pigeonholes for each message. Moreover, a given participant cannot change or create new or multiple associations (links) among the messages. Messages attach as notes associated with other notes, rather than as Web-like links to notes associated with specific character strings within a given document. There may also be severe constraints on the use of graphics and multi-media materials. Such software collects and files messages but does not mediate the group construction of an academic deliverable.

In face-to-face interactions, there is a huge difference between holding a meeting and working as a team. The important point is that asynchronous conferencing can be used to collect e-mail messages or it can be extended to support the creation of group products. To me, it makes more sense to use software that will allow a work-team manager or a teacher to capitalize on the advantages afforded by collaboration formalisms (Klemm, 1995). In my classes, all the on-line work is done in the asynchronous conferencing system known as FORUM98 (www.foruminc.com). When a group problem is being worked on, participants can put all their ideas and comments on a common topic into a single, scrollable file, rather than having dozens of separate e-mail messages, each of which has to be opened in a separate screen. I have used this environment specifically for Ainsight exercises@ (Klemm,1998c), case studies (Klemm, 2000), and even for supervising student research projects. See application papers at www.cvm.tamu.edu/wklemm/contents.htm. FORUM allows students to create a Web-like environment, in terms of in-context hyperlinking, but provides added features of pop-up notes and document sharing. The importance of hypertext to group thinking has recently been developed in a paper by Berg, 1999.

The hypermedia linking of FORUM creates what Spiro et al. (1992) would call a necessary environment for student mastery of complex knowledge domains. Hypermedia linking allows participants to bring together various knowledge sources in appropriate and specific contexts. Learning and group productivity are enriched, because students can revisit the same material for different purposes, at different times, in rearranged contexts, and from different conceptual perspectives.

FORUM also accommodates the Spiro paper=s admonition that it is not sufficient just to link everything with everything else. Some structure that supports teaching objectives is needed so that participants do not become lost in a confusing labyrinth of incidental or ad hoc connections. FORUM achieves this by creating categories or types of links and specifying how these can be linked - in short, a linking logic structure guides the constructivist activities.

In conclusion, what is wrong with many on-line discussions can be remedied by collaborative and constructivist practices in an appropriate software environment.

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Merged Structural Equation Model of Online Retailer's Customer Preference and Stickiness

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Abstract: Rapid explosion of the number of online retailers as well as online customers has been observed in these past few years. Comparable growth in sellers and buyers means that Internet retailers have to understand how to make customers prefer them to the competitors and make the customers loyal to their stores. Previous structural equation modeling study of customer preference and stickiness in online retail business revealed that some of the aspects that contributed to customer stickiness and customer preference were community involvement, convenience, site's appeal, entertainment aspect of online shopping and customer satisfaction and that these five factors contributed to customer preference and customer stickiness in similar fashion. The objective of this study was to investigate whether the two models could be merged. The analysis revealed that a merged model with customer stickiness as the indigenous construct could parsimoniously reproduce the pattern of covariation in the measurement model.

Introduction

As is the trend of Internet-fueled industries, these past few years have seen a rapid explosion of the online retail business, which includes an explosion in the sheer number of available products as well as the number of online stores. Internet retail sales are predicted to top $36 billion in 1999 in the US alone, a 145 percent jump from 1998 (Responsive Database Services 1999). Comparable growth in Internet buyers and Internet sellers can only mean that the Internet stores will face stiff competition to attract new customers to visit, to make customers prefer their sites over the competitors' sites and to maintain customer loyalty.

Finding ways to make a customer choose its store over its competitors is definitely one of the business targets of any Internet store. However, in the long run, efforts to make the customers stick to the store also play a role in the success of online stores. One of the ways to attract customers is through an intricately designed Web site (Violino 1999). However, online sales follow the philosophy of its traditional forms of sales: "customer is the king". With various options available in the Internet and the ease of switching from one e-retailer to another, without customer-oriented philosophy, it is difficult for an Internet retailer to make its customers to keep coming back to their shops and purchasing their products. As Federal Express Corp. CIO Chris Hjelm said, "In the Internet and e-commerce driven world, the customer is given the increased power of choice. Global competitors appear every day, and companies that provide the best customer service reach and keep customers at the expense of their competition." (Sweat 1999).

Review of Literature and Development of Hypotheses

What aspects of customer behavior determine why a customer would stick to a particular Internet retailer site? While most previous studies have viewed the solution from the company's side such as faster server, improved security, more user-friendly interface, etc, some studies and researches observing customer's perception and opinions on this topic have been performed by various companies and institutions.

A complete and positive customer experience is thought to be the key factor to customer retention and loyalty (Pelton 1999). It was also suggested that customer experience shouldn't be viewed solely through the lens of information technology, but also through entertainment and community. The author described community as a sort of affiliation, that if we purchase one particular product, we are proudly a part of this 'elite' community of owners (e.g. Harley Davidson, Saturn, Mazda Miata, etc). The author described facilitating entertainment as making browsing process become a form of entertainment in itself for customers, comparable to window shopping in real life. More strongly, it was suggested that an e-retailer site that fails to carefully compose customer experience will not effectively capture his/her interest, prolong visits or lead to purchases. This creates missed opportunities to increase customer contention and loyalty, and generate revenue (Eisen 1999).

One way to increase customer loyalty is to add features that let buyers personalize the site, automate product selection and comparison, and communicate instantly with a sales or service representative. E-commerce sites are also competing by developing community-building features, such as members-only sites that let people with similar interests communicate with each other (Blundon & Bonde 1998). A mechanism in traditional marketing used to assess and boost customer retention called "stickiness" in the e-commerce context was discussed by (Nemzow 1999). The author suggested that stickiness could be created through various ways ranging from brand awareness, frequent buyer program, to creating financial hurdle that discourages customers from switching to competitors.

To summarize, several aspects might affect customer stickiness of a particular online store, such as site's appeal, the community atmosphere the site created, the convenience the online store offered, customer satisfaction, the entertainment the site provided and customer preference.

Previous data-driven analysis of structural equation modeling (Kurniawan 2000) revealed that site's appeal, the community atmosphere the site created, the convenience the online store offered, customer satisfaction and the entertainment the site provided explained customer preference and customer stickiness in similar fashion. The objective of this study is to investigate whether these two models could be merged and if customer preference does contributes to customer stickiness as suggested by the literature.

Objectives and Summary of Hypotheses

The objective of this study is to test a model of customer stickiness in online retail business. To accomplish this objective a specific question was addressed:

What is the predictive relationship between customer stickiness and these six aspects: site's appeal, the community atmosphere the site created, the convenience the online store offered, customer satisfaction, the entertainment aspect of the site, and customer preference?

Based on the result of the previous study (Kurniawan 2000) where site's appeal, community involvement, convenience, customer satisfaction and entertainment explained customer preference and customer stickiness in similar fashion, it is hypothesized that the two mediated structural equation models revealed in previous study could be merged. The hypotheses are formulated as follow:

H1: The site's appeal, the community atmosphere the site created, the convenience the online store offered, customer satisfaction, the entertainment aspect of the site, and customer preference are positively related to customer stickiness.

H2: Customer preference will mediate the relationship between customer stickiness and the site's appeal, the community atmosphere the site created, the convenience the online store offered, customer satisfaction, the entertainment aspect of the site.

Methodology

Subjects and Data Source

The Graphic, Visualization, and Usability Center (GVU) at the Georgia Institute of Technology hosted in their Web site a series of questionnaires related to different aspects of computer use. One section of the questionnaire, called "Purchasing on the Internet" questionnaire fielded on October 10, 1998 through December 15, 1998 contained questions related to the different aspects that might affect customer attitude toward purchasing on the Internet. Five hundred randomly selected adult respondents (age 18 years and above) who purchased products or services through the Internet for personal use in the past three months before filling in the questionnaire and stated their annual incomes from 889 complete cases (100% non-missing data) were analyzed. The respondents ranged in age from around 18 to around 83 years (the age groups were re-coded using their medians), with an average age of 38 years (S.D. = 12.1 years). The sample was predominantly male (69%). The respondents have quite high education levels with only 10% have less than some college. The respondents also have quite high income (the income groups were also re-coded using their medians) with the average annual income of $63K (S.D. = $30K).

Measures

The instrument of the following measures is a 7-point discrete scale. The respondents were given a statement that they respond to by choosing from "Strongly disagree" to "Strongly Agree" about the customer's experience with the Internet retailer they recently purchased from except for the Community Involvement construct where the respondents were given a statement that they respond to by choosing from "Extremely uncharacteristic of me" to "Extremely characteristic of me" relating to their attitude about interacting with the Internet retailer they recently purchased from as well as its customers.. The list of questions and their related constructs could be found in previous study (Kurniawan 2000). The summary of constructs is listed in (Tab. 1).

Construct	*# items*	*Reliability (α)*	*Factor loadings*
Customer stickiness	8	0.863	0.49*** - 0.77***
Customer preference	12	0.942	0.63*** - 0.87***
Customer satisfaction	12	0.936	0.65*** - 0.85***
Entertainment	10	0.917	0.56*** - 0.87***
Community Involvement	9	0.872	0.52*** - 0.82***
Convenience	5	0.870	0.66*** - 0.86***
Site's appeal	5	0.884	0.63*** - 0.76***

Table 1: Summary of constructs, *** = $p<0.001$

Analysis and Results

The purpose of this study was to test the possibility to merge two structural equation models of customer preference and customer stickiness. It was hypothesized that customer preference will mediate the relationship between customer stickiness and the site's appeal, the community atmosphere the site created, the convenience the online store offered, customer's satisfaction, and the entertainment aspect of the site. Analysis focused on:

(1) Examining the correlational relationships between the items and their underlying construct and correlational relationships among constructs.

(2) Observing whether the site's appeal, the community atmosphere the site created, the convenience the online store offered, customer satisfaction, the entertainment aspect of the site and customer preference explained customer stickiness.

Correlational Relationships

	customer satisfaction	entertain-ment	community involvement	site's appeal	convenience	customer preference	customer stickiness
customer satisfaction	1						
entertainment	0.14**	1					
community involvement	0.13*	0.34***	1				
site's appeal	0.50***	0.49***	0.28***	1			
convenience	0.78***	0.11*	0.05	0.43***	1		
customer preference	0.84***	0.21***	0.15**	0.5***	0.73***	1	
customer stickiness	0.28***	0.58***	0.23***	0.34***	0.17**	0.41***	1

Table 2: The correlations among constructs, * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$

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Table values under the column *Factor loadings* in (Tab. 1) showed the correlations between the items with their respective underlying constructs. These values were obtained using Confirmatory Factor Analysis using Lisrel VIII software package (Jöreskog & Sörbom 1993). Moderate to high factor loadings (ranging between 0.49 to 0.87, $p<0.001$) were observed in all items.

Table 2 contains the correlations among constructs. The constructs represent 53.8% of the total variance accounted for by the 61 variables that grouped into seven constructs which constitute the model. The range of the correlation coefficients is quite large, varying from 0.05 to 0.78. All of the correlations are significant at $p= 0.05$ except for the correlations between 'convenience' and 'community involvement'. The correlation among variables was also provided by Lisrel VIII software but was not included in this paper because of their values were not directly relevant to the investigated model.

Latent Relationships

In order to determine the causal relationship between entertainment, customer satisfaction, community atmosphere, convenience, the site's appeal, customer stickiness and customer preference, structural equation modeling was employed (Jöreskog & Sörbom 1993). Structural equation modeling allows one to create latent constructs comprised of several observed variables intended to assess a particular construct. The advantage here is that the relationship between these latent constructs is disattenuated for measurement error. This technique also allows the predictive relationship between all latent constructs to be examined simultaneously. All structural models were estimated using the LISREL VIII program (Jöreskog & Sörbom 1993). Models with Chi-square (χ^2) estimates less than two times the degrees of freedom (Akaike 1987), residual error less than .05 and overall fit indices above .90 were considered adequate fitting models.

Analysis began with the specification of a measurement model where the constructs are correlated to one another. The specified measurement model included some correlated measurement errors of variables that represent the same constructs. This measurement model had an adequate fit: χ^2 (2288)=4544.60, residual error < 0.05, most fit indices > .90. Next, a series of structural equation models was performed in order to determine the pattern of relationship between the latent constructs that would most parsimoniously reproduce the pattern of covariation in the measurement model.

The first structural model was the hypothesized model depicted in (Fig. 1). Although the fit of this model is adequate: $\chi^2(2303) = 4580.21$, it was significantly different from the initial measurement model: $\chi^2(\text{diff}(15))= 35.61$. Therefore, more iteration is needed.

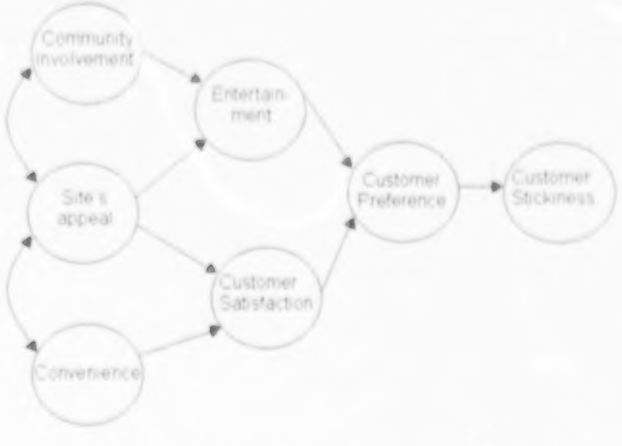

Figure 1: Hypothesized model of customer stickiness

Based on beta's modification indices, there is a significant relationship between entertainment and cusstomer stickiness. Adding predictive relationship between these two constructs yields a new $\chi^2(2302) = 4570.89$ and a χ^2 difference with the measurement model: $\chi^2(\text{diff}(14))=26.29$. The last model has adequate fit, is not significantly different from the initial measurement model, and has no more significant beta modification indices. Therefore, this model is considered as the final model. The model is depicted in (Fig. 2).

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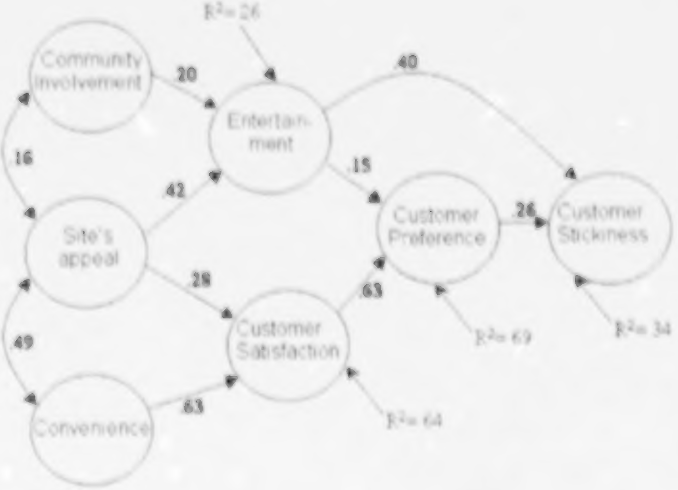

Figure 2: The final model of customer stickiness

Discussion

The current study attempted to examine a structural equation model of customer stickiness in e-retail business by examining the possibility to merge two previously tested structural equation models of customer preference and customer stickiness (Kurniawan 2000). The Confirmatory Factor Analysis of the observed variables produced factor loading values listed in (Tab. 1) showed that the variables load on relevant factors with medium to high loadings, indicating that those variables well represent the intended underlying constructs.

The pattern of correlational relationships as shown in (Tab. 2) is congruent with the literature and supports the first hypothesis (H1). That is, the site's appeal, the community atmosphere the site created, the convenience of shopping online, customer satisfaction, the entertainment aspect of the site and customer preference correlate positively with customer stickiness. It led to the conclusion that if the e-retailers facilitate these factors, customer stickiness would in turn be facilitated.

The final model showed that only customer satisfaction and entertainment predict customer preference in direct way. The effect of community involvement and site's appeal on customer preference and stickiness was mediated by entertainment while the effect of site's appeal and convenience was mediated by customer satisfaction (see Fig. 2). The implication of the results is intriguing. It suggests that although the customers recognized that shopping on the Web is convenient which brings satisfaction to them, some customers might not feel it entertaining. In similar fashion, the feeling of being part of the community affiliation of a certain Internet retail site might be entertaining to the customers, but it doesn't necessarily lead into customer satisfaction. As an illustration, being part of Apple® community because of owning one might be fun, but does not necessarily bring about satisfaction. The fact that the effect of site's appeal and convenience on customer preference is fully mediated by customer satisfaction means that although by looking at the bivariate correlation it seemed that site's appeal and convenience predicted customer preference, their effects are only indirect effects.

The variation of customer satisfaction was better explained by its predictors than those of the entertainment, showed by a much larger squared multiple correlation coefficients (R^2).

The other noticeable result was that site's appeal was correlated with both the community affiliation involvement and convenience. The fact suggested that by designing an appealing Web site, the customers would feel that their shopping experience on the Web is a convenient experience. A proper design of Web site would also boost the feelings of being part of the elite community of this particular product's users.

Turning to the second hypothesis of the study, the structural equation model does not fully support the hypothesis. Customer preference fully mediates the relationship between customer stickiness and the four constructs: the site's appeal, the community atmosphere the site created, the convenience of shopping online and customer satisfaction. However, there is direct relationship between customer stickiness and entertainment. The

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result implied that customer stickiness could be facilitated by ensuring that the four constructs facilitate customer preference. However, it is not enough to ensure that entertainment facilitates customer preference to guarantee customer stickiness. Entertainment aspect of online shopping by itself is predictive of customer stickiness.

Conclusion, Limitations and Further Direction

The main aim of the study is to investigate the underlying constructs of customer's experience and find out the model of correlational relationships among different constructs of customer's experience. The outcome of the model is customer stickiness, as suggested by various literatures to be the outcomes desired by e-retailers. Two hypotheses were developed based on literature reviews. The study found that the first hypothesis was supported and the second one partly supported. The final model is depicted in (Fig. 2).

Due to the cross-sectional nature of this study, statements regarding causality among the hypothesized factors can not be made. Instead, the identified pattern of predictive relationships should be considered as a first step in determining the relationship between customer stickiness and various possible underlying constructs, as well as the interrelationships that exist among underlying constructs. The limitations of using a convenience sample should also be acknowledged. This data was analyzed with the data from GVU data that contain more long-term, sophisticated computer users than the general population (Hoffman, Kalsbeek & Novak 1996).

With the e-commerce, e-business and e-retail increasing at almost unimaginable speed, exploring the psychology of Web use in the area of e-retail would be the first step towards understanding what work and what doesn't in order to make the customer stick to a particular e-retailer. The growing complexity of e-commerce technologies coupled with rapidly rising customer sophistication, makes focusing on user even more important. The next step would be to create a way to make certain that this knowledge could be realized and applied to the design of the Web site as well as the process of e-retailing. Further studies in the area of Web design usability and retail process evaluation from user's perspective would be fruitful for both the customers and the e-retailers.

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FORGING PARTNERSHIPS AND NETWORKING LEARNERS THROUGH THE HETS CONSORTIUM

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Abstract: Forging partnerships and collaboration within the consortium has been a continuous learning process for Hispanic Educational Telecommunications System (HETS) consortium. This paper will examine the accomplishments, and lessons learned throughout the planning, coordination, and development of this consortium. The paper addresses several challenges and successful solutions that have been part of the HETS development process. Major challenges included the integration of technologies to widen interconnection opportunities, the language and cultural diversity among the members of the constituency, the organizational structure of the consortium, the planning and coordination of program offerings, faculty training and collaboration, and building a virtual leadership through a distributed team of institutional representatives.

Introduction

Throughout the last two decades there has been a growing trend for distance education projects to develop through inter-institutional collaboration. Consortia for distance education have developed as an opportunity for institutions to share their knowledge resources and join efforts for collaboration and growth. As the challenges and expectations for educational telecommunications rise, forging partnerships and networking learners seems to be the logical path for the expansion of colleges and universities in an information society.

In 1993, realizing the growing opportunities for distance learning in higher education to serve the Hispanic community, nine post-secondary institutions in the United States and Puerto Rico established the Hispanic Educational Telecommunications System (HETS). Through the years the consortium has grown and today HETS is constituted by sixteen colleges and universities in the states of Arizona, Florida, Mississippi, New Mexico, New York, Texas, California, and Puerto Rico. Also, a collaboration agreement has been established with the Virtual University of the Technological Institute of Monterrey (ITESM), in Mexico.

The main purpose of HETS is to increase post-secondary education and training opportunities for Hispanics in a distributed learning environment. HETS' vision is to build a virtual community of faculty, students and professionals for learning, support, and collaboration. The greatest challenge for HETS member institutions is to work together in developing, delivering and sharing programming through the Internet and its satellite network system. HETS encourages the dissemination and sharing of informational and instructional materials, the enrichment of curricula offerings, and the improvement of the overall educational experiences through distance learning technologies and initiatives.

HETS provides the opportunity for affiliated institutions to offer and deliver educational and training programs, courses, and conferences across distances to reach out geographically distributed Hispanic communities. Each participating institution brings its particular strength and its own diversity of program offerings that may be attractive to students enrolled in other colleges and universities.

Distance learning today is largely about building partnerships and collaboration, particularly in view of grant opportunities encouraging institutional alliances. A recent grant from the FIPSE Learning Anytime Anywhere Partnership program of the U.S. Department of Education allowed HETS to develop a Virtual Learning and Support Plaza. Through the collaborative effort of its member institutions, the consortium is able to create a virtual community of faculty, students, mentors, and working adults for learning and support, from anywhere and at anytime, on the Internet.

Widening Interconnection Opportunities Through Integration of Technologies

The majority of the HETS affiliates are Hispanic-serving institutions, each with a distance education infrastructure and program at a different stage of development. Some affiliates are fully equipped with a diversity of telecommunications resources, well organized and experienced with distance education within their states or localities. Other affiliates are currently upgrading their technological infrastructure and organizing the management of distance education.

In 1995, a U.S. Department of Commerce grant was awarded to the consortium to acquire and integrate an uplink/downlink satellite network system with their existing distance learning infrastructure. However, constraints of the satellite system, including synchronicity of scheduling and transmission costs limited program offerings for the consortium. To date, more than half of the member institutions can connect to each other through a C-band satellite network system, sharing similar transmission and reception equipment for compressed digital audio and video. The other institutions connect through switch-56 or ISDN. The affiliates are well equipped with respect to their overall telecommunications capability. All affiliates have electronic classrooms and wide area networks connected to the Internet and all of the institutions can communicate with each other through the Internet.

Members of the Operations Advisory Council are now assessing the specific technical configurations for distance learning at each affiliate to explore and encourage a greater integration of technologies among all member institutions. This means that the technical network is a hybrid system to provide for greater possibilities of inter-institutional connections.

The consortium has realized that the technological configuration that connects its affiliates must be flexible, diversified, updated, and fully integrated to other telecommunications technologies at member institutions. This approach helped drive HETS to seek new opportunities for connectivity beyond its original satellite network. This lead to a policy issue regarding the outreach to new affiliates. The focus changed to the use of multiple technologies to bring the best solutions to distance learning within the consortium. For example, offerings during the 1999-2000 year included special events shared via the satellite network and ISDN, the webcasting of a medical conference, and an online course for faculty development titled "How To Teach Online".

The main strategy now is identifying needs and opportunities for partnerships within the consortium to collaborate. The short-term objective is to optimize the shared telecommunications infrastructure and to increase the interconnection and networking possibilities among all the HETS affiliates, as a consortium, by integrating technologies.

Language and Cultural Diversity in the HETS Constituency

While member institutions vary greatly in the size of their student populations, the consortium has a significant Hispanic/Latino student population representing the cultural diversity within the common heritage of this community. The majority of the Hispanic student population at the affiliates in New York and Puerto Rico are Puerto Ricans, Dominicans and Central Americans. At the affiliates in the southwest/west region they are Mexican

Americans and Hispanic Americans, and in Florida they are Cuban Americans. In almost half of the affiliates (46%) the Hispanic students use Spanish as their dominant language of conversation. At four institutions (26%) students are bilingual. Only 26% use English only as their language of conversation. This profile is important when considering the design and development of the program offerings based on the regional areas of service.

One of the greatest assets of consortium is the ability to provide a multicultural network environment for intercultural exchange and understanding. There is a great opportunity to promote bilingual communication among faculty and students of Hispanic heritage through different regions. The flexibility of HETS affiliates to offer courses either in English or Spanish promotes cultural diversity and awareness among the participants. As for the HETS Virtual Plaza, the flexibility of offering courses and workforce training in both languages provides a larger marketing scope for learners willing to choose contents based on their language preferences.

An Organizational Structure to Insure Organizational Development

Any consortium needs a reliable organizational structure, distributed across its member institutions, in order to grow and consolidate. The organizational structure of HETS relies on a highly committed Board of Directors, comprised of the Presidents of member institutions, three advisory councils, and an executive director housed at a main office with a small staff. The three advisory councils guide and assist the Executive Director in the consideration of academic, technical, and continuing education issues. Each affiliate has a primary contact person and a representative on each of the three advisory boards.

The organization fosters a distributed leadership to assure that institutional leaders are involved and committed to a shared vision and mission for distance learning. This distributed leadership and organizational structure require support and incentives at the institutional level. Although it is seven years from the inception of the consortium, the structure is still developing on some of the affiliate campuses. Only about half of the affiliates have a strong level of participation through the advisory councils.

The project for the Virtual Plaza, funded by FIPSE, allowed HETS to reorganize its constituency in three regional areas to facilitate coordination: the southwest region (Arizona, New Mexico, California, and Texas), the northeast (New York) and the southeast (Florida and Puerto Rico). A regional coordinator and an online counselor at each region works with selected faculty from different institutions to develop online courses and support strategies for learners using the Virtual Plaza. This team is supported by an online instructional designer, and by the main office staff, including a Web Manager. The fact that this project management structure is funded by a grant will lend to a comparative assessment of organizational progress and growth at the different affiliates by regions.

Using a Distributed Team to Build Partnerships and Foster Virtual Leadership

The consortial effort has appeared to be a huge and ambitious project to our member institutions. This is in part because smaller partnerships have not yet been developed within the consortium. A recent survey completed to assess the affiliates' needs and opportunities for distance leaning, allowed HETS to identify where and how each member institution could collaborate with the others. The development of the Virtual Plaza encourages partnership building between faculties from different affiliates to develop online courses in a collaborative manner.

The current strategy is to reorganize into smaller groups of partner institutions to work together in developing and delivering new courses and programs. For example, a unique program on Bilingual Journalism was identified and can grow out of an inter-institutional collaboration and teamwork of faculty members at Lehman College (CUNY) in New York, the University of the Sacred Heart in San Juan, and the University of Puerto Rico. These three universities have recognized Communications/Journalism programs, and a new program in Bilingual Journalism is of interest to many students. While this example is based on the similarity in offerings, other groups form based on proximity. The University of Texas at Brownsville and the University of Texas-Pan American are collaborating on the implementation of faculty development programs.

The strategic action of encouraging and supporting the development of partnerships within the consortium lead to a greater number of programs identified for distributed delivery. However, adopting this approach requires strong leadership and effective communication between the HETS central office and the HETS member institutions. In circumstances where our teams are geographically distributed throughout several regions, the virtual leadership[1] from the central office and from institutional members is essential for building trust and sharing a vision as a group of partners and collaborators.

Overall, the consortium has to involve more faculty and academic managers committed to distance learning. Institutional representatives are increasing interaction through email, listserves and a Web bulletin board to plan and coordinate activities. Using these media, members gain trust, identify potential partnerships opportunities, and provide greater support to facilitate virtual teamwork and collaboration training. Providing and managing these virtual leadership and work team strategies is a priority for the consortium as a whole and a sound investment for its member institutions[2].

Planning and Coordinating Programming Offers

Through the years, the critical issue for the consortium has been establishing and consolidating a program offering. During the consortium's early years, funding, planning and coordination were the major constraints to the sharing of a course or courses. The Academic Advisory Council, representing member institutions' academic interests, suggested courses for delivery through the satellite network. However, inter-institutional mechanisms for delivering and receiving courses, as well as the high cost for transmission constrained the consortium's use of videoconferencing. Even with the advent of online offerings, one of challenges is still that of providing broad and consistent offerings.

The 1999 Operational Plan included an assessment of the needs and opportunities that our member institutions have for distance learning. A survey to assess the technical, the academic and the organizational development of member was completed. The results of this survey allowed HETS to identify needs and potential opportunities for collaboration within the consortium. HETS is using the results to plan for growth and consolidation of the consortium. This means building greater opportunities for member institutions to expand their distance learning initiatives to other regions.

In the survey, over 2/3 of the affiliates identified Education, Business, Information Technology, Nursing & Health Sciences as areas of highest demand by Hispanic/Latino students. The Natural Sciences, Social Sciences, Humanities, Communications and Engineering have a slightly lower demand. The areas of highest demand for continuing education include Business, Information Technology, and Education. The focus for course or program offerings emphasizes delivering minors, professional certificates and workforce training in these most demanded areas.

Each affiliate has at least one unique academic program at their institution. Also, most affiliates have unique academic/research centers dealing with Hispanic issues. These centers can use the videoconferencing system and The Virtual Plaza to disseminate their research findings and service strategies. The affiliates also have strong areas through which they can contribute to continuing education programming and most have identified the continuing education needs of their local Hispanic/Latino communities. The greatest needs are in the areas of Entrepreneurship, Community Economic Development, Health & Wellness, Drug & Addiction Prevention, English as a Second Language, and general equivalency degrees (GED). These needs are of particular importance in addition to the workforce competencies that Hispanics need in order to increase their participation in the information economy.

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[1] For a philosophical view about the process of virtual leadership see Jaclyn Kostner. Virtual Leadership (Warner Books: New York, 1994).

[2] See Virtual Teams: Reaching Across Space, Time, and Organizations With Technology, byJessica Lipnack & Jeffrey Stamps. (New York: John Wiley & Sons, 1997.)

The survey also identified a natural market or 'feasible niche" for programming based on the cultural identity interests of the Hispanic/Latino community. The major areas are Latin American studies; Ethnic Studies (Mexican American, Chicano, Puerto Rican studies); Caribbean studies; English as a Second Language; Spanish as a Second Language; Hispanic American Literature; Bilingual Education; and a Translation/Biliteracy program.

Together multiple providers represent a pool of knowledge resources and a variety of academic and training programs that can be offered by the affiliates, individually as well as in partnerships, without competing. All the affiliates have expressed interest in collaborating with each other. Some of them indicated specific institutions with which they are interested in joining efforts for distance learning initiatives. With much more information about programming possibilities and the institutional profile of each affiliate clear, Board and council members are now exploring together specific partnership opportunities within the consortium.

The most common procedures or strategies used by affiliates to propose distance education courses are through faculty initiatives and departmental proposals. This means that distance education opportunities through the HETS satellite network and The Virtual Plaza are promoted directly among the faculty members and at departmental levels.

The most critical issues that affiliates have confronted in the past for programming and delivering distance education through HETS are staff and technical support, budget, promotion strategies, and coordination with other institutions. Many of these difficulties are addressed temporarily through the funding support and organizational resources provided through the FIPSE grant. Nevertheless, institutions must continue strengthening their own distance education divisions and their leadership initiatives to foster collaboration.

Faculty Training and Collaboration: Reducing the Risk of Trauma

A range of 5% to 25% of the faculty at the member institutions are involved with distance education. Lack of incentives and of training, insufficient administrative support, and the perception that distance education is too difficult are the main reasons affecting this low faculty involvement. Strategies to increase faculty involvement entail incentives and greater staff support, encouraging and making faculty participation easier in distance learning projects.

Distance learning is a field constantly changing because it depends intensively on information and communication technologies that are converging through telecommunications and computer networks. Innovative teaching and interactive strategies are also required to enhance distance-learning environments with appropriate uses of new technologies. All these new trends in education are strong pressures over faculty and staff for changes in the ways they teach, communicate or manage institutional processes.

A different approach to distance learning often implies getting faculty and staff involved in changing paradigms, attitudes and strategies. The amount of change and the number of people involved in the change process are two variables inversely related that might be explained by the Model of Risk/Trauma[3]. What this means is that if the consortium expects all its affiliates to deliver, at the same time, a whole set of courses and programs through both its satellite network and the Web, there is the potential for a high level of institutional trauma to faculty, academic managers and staff.

To lower the risk of change trauma we have been requiring, instead, from all member institutions to get involved with a "low risk" distance learning activities through the satellite network. This strategy includes producing and delivering one-day videoconferences for continuing education topics, or inviting small groups of faculty members from two or three member institutions, in one specific discipline or professional field, to meet for a virtual colloquy.

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[3] Dr. Ted Metcalf, presentation at the Distance Learning Administrator Certification program, Center for distance learning research, Texas A & M University, June 1999 session.

To date, some institutions have successfully delivered one-time videoconferences that have been received by several affiliates. These smaller initiatives have been productive for integrating technology, networking people, sharing experiences, coordinating efforts, establishing institutional mechanisms, and finding solutions to technical network difficulties. A series of videoconferences offered during fall 1999 in celebration of the Hispanic Heritage Month and the web-casting of the 2nd International Border Medical Conference during March 2000, was an opportunity for all the above.

As a small number of faculty members from a group of affiliates get to share ideas and perspectives, they get to know each other and feel confident in getting involved with distance learning through virtual teamwork and collaboration. Consequently, they are encouraged to collaborate in developing and delivering new set of courses. Additional promotion of collaboration involves a faculty training approach by involving peers from several member institutions, experienced in distance education, to serve as mentors.

Using Partnerships and Collaboration To Build the Virtual Plaza

As the Internet expands, production of online resources requires greater knowledge management, communications and collaboration, particularly for the benefit of underserved learners. By 2006 Hispanics will form the largest minority group in the US and by 2020 will account for 20% of this total population. However, their educational achievement has not kept pace with their increasing share of the population and labor force. By gaining access to anywhere-anytime learning opportunities Hispanics will be prepared to have a positive impact at all levels of American society. Realizing the great potential of the Internet to widen access to postsecondary education and workforce training, HETS developed a Virtual Learning and Support Plaza through the collaborative effort of its affiliates.

The major goal of the five-year Plaza project is to develop an interactive Plaza encompassing an impressive array of credit courses and training workshops, developed and delivered by multiple providers. The primary goal of The Plaza is to build a virtual community for learning, collaboration, and support by networking students, faculty, counselors and professionals. Mentoring is fostered within the Hispanic cultural context where *Padrinos* (Godfathers) and *Madrinas* (Godmothers) care for the persistence and success of learners. Selected faculty members are compensated, trained, and supported online to develop content and learning strategies. Quality standards are met using criteria for selecting faculty such as relevance of proposed content area, adequacy of interactive learning design, and degree of inter-institutional collaboration.

Hispanic-serving institutions have a single site through which to promote and link their growing online course offerings. Employers have a targeted cyberplace to test and offer workforce training online. There is hope that eventually, the information industry will be able to try new groupware applications for online collaboration. Evaluative data is collected continuously and includes both process and outcome measures. Outcome evaluations focuses on student learning, persistence, motivation and retention, all measurable with quantitative data.

Promotion of The Plaza occurs through Hispanic-serving institutions, public libraries, business and community organizations and will include Web marketing strategies. Inviting other HSIs, professional and business organizations to add content assures sustainability. Active participation in national conferences and faculty research opportunities to study the impact on student learning contributes to The Plaza's expansion. HETS does and will continue to ensure equitable access and participation by any student or adult learner interested in registering in The Plaza. We estimate that, through the five-year period from 2000-2004, approximately 100,000 individuals will visit The Plaza, register in online courses, and engage in communicating with faculty, peer counselors and mentors.

Concluding Remarks

This paper presented some of the organizational learning experiences of HETS, a consortium for distance education. Through this learning process the consortial management and leadership have realized that distance-learning initiatives through partnerships is mostly about networking people, planning and coordination. HETS is the only telecommunications consortium with a clear stated vision and mission to serve the Hispanic community through distance learning. In the midst of the information age and the knowledge society, and has a great potential for diversification and growth. HETS is a great academic and technological resource opportunity for other Hispanic Serving Institutions, national Hispanic organizations, and the industry to collaborate and coordinate the development and delivery of courses and workforce training through the telecommunications network and the Internet.

TOOLS FOR PERSONAL TASK ORIENTED KNOWLEDGE: SEARCHING, CLUSTERING, and INDEXING WEB RESOURCES

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ABSTRACT: The open nature of the web, with its vast body of disparate information resources, presents a challenge in efficient and effective identification of relevant documents for the knowledge worker. In this paper we describe a system, a set of tools, that assists individuals with the task of managing their personal knowledge. The system incorporates a user-centric search facility, a clustering technique to extract and organize retrieved documents, and a personal indexing system to organize content in a personally relevant manner.

Introduction

For thousands of years the majority of work was manual work - work that entailed the visible manipulation of materials. Work was transferable to others via observation or algorithm. As time progressed, much of the work was automated and human work and working shifted from manipulation of materials to manipulation of information and knowledge. "Instead of converting instructions and procedures into actions that in turn converted materials from one form to another, the task was to convert knowledge into actions which converted information from one form to another."

The growing interest in knowledge management by organizations has focused on capturing, codifying and sharing knowledge held by people in those organizations through the creation of knowledge repositories, improving knowledge access, enhancing the knowledge environment, and managing knowledge as an asset (Davenport, 1999]. From an asset or commodity point of view, we can consider the web a media-rich information resource, a body of explicit knowledge or knowledge repository. From a more procedural or strategic point of view the web provides a resource of information from which one derives knowledge (knowledge as a state-of-being) or discerns which knowledge and methods apply.

The open nature of the web, with its vast body of disparate information resources, presents a challenge in efficient and effective identification of relevant documents for the knowledge worker. The challenges of information access on the internet are issues common to all forms of information retrieval. This issues include difficulties in using indexing vocabularies, indexing indeterminancy, and the user's ability to completely specify information need (Ingwerson, 1986). Retrieving information that meets users' information needs is an iterative process, and techniques which explicitly incorporate users' judgments, such as relevance feedback (Maron, 1960), provide means to automate some aspects of user guided retrieval. It is also clear that mechanisms providing alternative paths of access to information can enhance retrieval effectiveness (Bates, 1986).

Information is retrieved, culled, transformed, and finally applied. It is the responsibility of the knowledge worker to figure out what to cull, how to transform and when to apply. This process is not always well codified. As a result, the transfer of knowledge from one individual to another is not a simple task. Knowledge management facilitates this process. It is about people and performance and leveraging knowledge to improve the Knowledge transfer process, and should not be equated with knowledge management technologies. In this paper we describe a system, a set of tools, that assist individuals with the task of managing their personal knowledge. The system incorporates a user-centric search facility, a clustering technique to extract and organize retrieved documents, and a personal indexing system to organize content in a personally relevant manner.

Searching

The internet provides accessibility to an unprecedented amount of information. While the promise of the web lies in the ability to produce complex, richly connected, cross-referenced sources of information, in reality, the web is a cacophony of information, which can confuse both the author and the reader. In general, there are no simple organizational schemes that can serve as ubiquitous and commonly understood paradigms for navigation and retrieval of information.

While search engines and directory services assist in retrieval of information, problems arise in efficiency and quality. The problems relate to the search philosophy based on keyword or indexed searches and the difficulties in using indexing vocabularies, indexing indeterminancy, and the user's ability to completely specify information need. The search becomes search engine-centric and assumes all users are the same and the keywords or indexing terms mean the same to all users. However, keywords carry different meanings within different domains and even within the same domain have meanings dependant on the users' expertise in the domain knowledge and language vocabulary. Research on use of semantics to perform querying is worthwhile and will ultimately increase search query relevancy.

None-the-less, we believe any successful search should be user-centric There are two viable approaches to performing user-centric searches: user profile methods and personal information environments, .or PIE (French, 1999). PIE is a conceptual architecture that allows unified, customizable access to info by providing users with tools to compose personalized collections from a palette of information resources. Any search is done within this personalized collection. This can be effective if the collections capture all of the user's interests. In user profiling, a profile of the user is created and used during a search, but an issue arises concerning how to determine an accurate user profile. Meng, et al. (1998) suggest a profiling method that uses the "digital signature" on a user's host machine to build an index of words. While limited work has been done in this area, it seems to be a viable alternative to search engine centric searches.

User-Centered Web Searching - Creating Concept Dictionaries

The method we use for document retrieval is a user-centered, profile based method. Our implementation choices were influenced by the following observations: The internet has a large amount of information. A given user needs only a fraction of the information available. A user has interest or "lives/spends his time" in only a tiny part of the internet. Further, users are creatures of habit: they tend to request information similar to that which they have previously seen. Emerging from these observations, the user's web history can be and is used to build a user profile of the perceived web resources of interest. That is, we associate the user's use of keywords in a particular topic area of the web with a concept, and subsequently creating a concept dictionary, which provides a mapping of keywords to a particular individuals concepts based on their interests.

For example, the concept 'energy' carries entirely different meanings for different users - microbiologist, physicist, politician, exercise fitness expert, or food nutritionist. A search using the keyword "energy" and the Altavista search engine yielded over 4,000,000 hits on March 8, 2000. Only a few of the multitude of hits were of interest to the physicist, who likely thinks of energy more specifically, as particle energy, nuclear energy, kinetic energy, potential energy, or free energy. For the physicist, we create a concept "energy" which is described by the more specific terms outlined above. A chemist on the other hand, might have the same concept 'energy', but described with a disjoint set of keyword terms including bond energy, entropy, chemical energy, and activation energy. Concepts then are a keyword based profile of the user's use of keywords in a particular topical portion of the web, or in other words, a dictionary mapping more specific keywords to a more generalized concept.

While the simplest approach to creating a concept dictionary is a manual process, problems still remain relating difficulties in using indexing vocabularies, indexing indeterminancy, and the user's ability to specify information. Thus, the preferred method involves automating the concept creation process. Given an indexing tool which allows users to create a personalized and cross-referenced index of their information resources, the terms can be extracted from the tool and used to create an concept dictionary (see later section of paper) (Lawrence-Fowler, 1998).

User-Centered Web Searching - mySearch Engine

To complete a search using mySearch Engine, the user supplies a concept word. The user's concept dictionary is consulted and keywords describing this concept are retrieved. The concept name and keyword(s) are combined using Boolean expressions using AND, or NOT or " " or () to form queries. The queries are submitted in parallel to one or more search engines. The results of the queries are collated and stored for further processing. If however, the concept is not present in the dictionary, a normal query is performed. The structure of mySearch Engine is presented in figure 1.

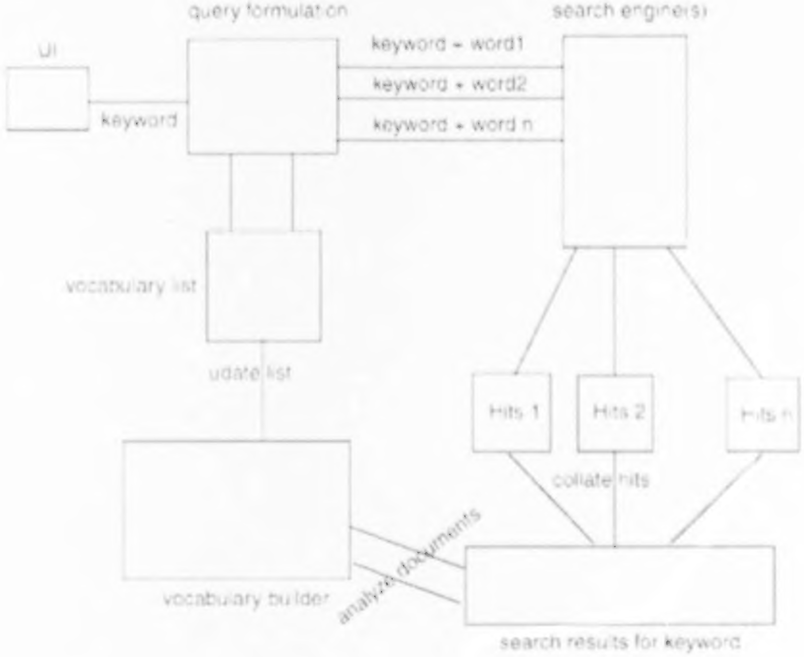

Figure 1: The structure of mySearch Engine.

Clustering

While the results of mySearch are collated, the results are still somewhat overbearing with respect the amount of organizing the user must complete to make the resources manageable, because there is no inherent organization in the collated document set. Given the ability to process document text, it is possible to automate an organizational process which alleviates a tedious hand process of clustering documents by content. Thus, the results of mySearch are feed into a clustering process to provide an organization structure based on document content.

Keyword lists for each document are created to determine the associations among documents and among terms. The statistical text analyses rely on recovering conceptual information from natural language by considering the frequency and co-occurrence of words. This basic approach has been used in a wide range of contexts and its utility and limitations are well known (Salton, 1989). The document representations are minimum cost networks derived from measures of term and document associations. The associations are derived from natural language text for queries, single documents, and an associative term thesauri. The retrieved document collection is represented as a network of documents based on inter-document similarity. Deriving the term associations For each set of retrieved WWW documents the system uses a separate set of terms formed from the most frequently occurring word stems, excluding function words. For some forms of retrieval this simple procedure suffers from the limitation that frequently occurring terms have relatively little value for discriminating among documents (Sparck Jones, 1972).

However, one function of the associative thesaurus is to give a picture of all of the concepts in a document set. The most frequently occurring terms tend to be general terms that provide useful information about the domain of the document collection. To derive the distances between terms used to construct networks, text is analyzed by first finding the sequence of term stems present in the text. This sequence is used to assign distances between terms based on lexical distance and co-occurrence in syntactic units with a metric similar to that used by Belkin and Kwasnik (1986). Term pair similarity is calculated as the sum of values added when terms are adjacent, or occur in the same sentence, paragraph or document. These similarities provide the associations used in deriving the networks displayed by the system.

There are three reasons for using statistically-based associative structures in an interactive browsing system. One reason follows from the view that information retrieval systems should supply the user with a variety of tools and retrieval techniques. Statistically-based associative information structures provide one class of retrieval tools that can complement other retrieval aids. For example, an associative thesaurus based on term co-occurrence in documents presents a structure of term relationships quite different than presented in a thesaurus showing term hierarchies. The associative thesaurus can encourage browsing and exploration, as well as bring the user's own associations into play. For information needs in which the user is not familiar with the domain, and indeed may not even know what his or her information needs are, the associative structures provide one means to explore and gain information to better define the information need. A second reason for using statistically-based associative structures is the desire to have a representation that can be derived automatically in an interactive system, rather than through knowledge-engineering efforts such as are required for most deep representations. Associative structures have been used effectively as one component of hybrid systems incorporating both deep and shallow representations (Crift&Thompson, 1987). The final reason is the desire to provide a common visual representation for retrieval tools. Networks are naturally represented visually and can provide a common representation for the system's several visualization components.

Personalizing the Clustered Document Resource Creating a Personal Index

Systems which provide facilities for organizing and viewing document organizations based on semantic content are less common than systems, which focus on visualizing document link structure. Mukherjea, Foley, and Hudson (1995) describe a system that operates on semantic content of WWW documents to form visually displayed hierarchies. In this system users specify attributes which affect the organization of documents derived by the system and reconfigure the display to suit their needs. VR-VIBE (Benford, 1995) is a system that places documents on locations in three-dimensional space by allowing users to interactively position keywords on a pyramid. Document locations are determined by calculating the distance for each document from keyword locations on the pyramid. In this way, users create visually distinct clusters of documents for continued inspection. Gershon et al.(1995, 1994) describe a system that allows users to view an organization of documents visited as a hierarchy of links and also to construct a separate hierarchy based on their own needs.

These systems all contain features that Halsz (1988) identifies as important components of to be addressed in hypertext systems: dynamic or virtual structures and extensibility, or tailorability. Users should be able to 1) organize content in a meaningful manner by adding user-defined relations between and within documents, 2) extend the information by adding user defined content to existing web documents, 3) display html and user defined content in a task oriented manner, and 4) reduce cognitive overhead by allowing the users to define their own indices, using their own terms, based on their own understanding. Facilities providing these functions should allow users to focus on the information in a manner that makes sense for their particular task rather than on the extraneous details associated with the information.

In this system, the results of the clustering process, the retrieved document set represented as a network of documents based on interdocument similarity, is accessed using a dynamic user-defined searchable indexing system (DUSIE). DUSIE is open indexing system, which provides the sort of functionality suggested above for augmenting Web/document set structure. Users construct a personal view of the web or a personal repository of concepts/information and concept/information relations to compliment the existing web structure. Users create alternatives to the link structure provided in the clustered document network. Annotation facilities allow the user to extent and/or modify content by 'posting' a note on a web page. With annotation facilities and the additional ability to cross-reference, the index is often more relevant to the user than an index created by the original author or the clustering process.

The user creates a virtual structure or personal model of web hypertext through a user defined indexing scheme. The virtual structure, or user-defined index, has two levels: the index term level with annotation capabilities and the hypertext base level, in this case the document network. The index term level is made up of a set of index entries. Each entry consists of term descriptors or keywords supplied by the user, locators (points of interest in a document), and 'posted' annotations. The keywords are as general or as specific as desired by the user and there is space for the user to add comments to the terms. Any particular keyword provides a focus for a set of related concept descriptors and thus a broadening or refinement of the concept represented by the focus index term. The keywords and the set of related concepts then create a structure that can be used to support query by navigation - navigation through conceptual space. In turn, these indices provide immediate access to required information without navigating through the document space.

When using DUSIE, the user defines term descriptors or keywords, and new index term nodes are inserted into the index level. Links are made from the index term nodes to user specified locations in the hyperbase - hypertext documents. Annotation facilities allow the user to add comments to the keywords themselves and to post notes pertaining to the web document content. The later annotations appear as post-it notes and are placed on the document by the user in the desired location. As new index terms are defined and links to the hyperbase are created, content relationships are defined through lists of keywords and implied by overlapping use of keywords. This creates a set of index entry nodes linked together through explicitly and implicitly defined relationships. It is assumed that the user perceives relationships among terms included in a single keyword list and among content areas indexed by the same keyword. As the users' perceptions of the content materials change, users can modify the index term network by adding or deleting links between keywords and links between the hyperindex and the hyperbase.

A Knowledge Management System

As an integrated set of tools, mySearch, the clustering process and DUSIE, facilitates the retrieval and management of information resources in an efficient and effective manner. A knowledge worker can retrieve relevant documents based on their own concepts of a domain using parallel queries. Collated results are clustered automatically based on document content. The resulting document network can be viewed and the user can modify the organization to meet their own needs.

Users can move directly to the desired information as well as access related information without having to remember locations, links or other structural details. In turn, the user defined index can be used to provide concepts for the mySearch component. This provides an alternative route for the automated generation of concepts and leads to an even greater degree of search customization. In a knowledge handling environment, workers can add notes to content, i.e., annotate content. Workers establish their own organization of materials - either by superimposing a different organization (link structure) or by enhancing the existing link structure. The tool reinforces knowledge acquisition through the active construction of an associative network of terms and annotations. Workers can define an index that explicitly defines their understanding and use of concepts. They can impose their own relationships on the information and modify their ordering as their perceptions change. The index reflects the worker's conceptual domain and can be used to retrieve information efficiently.

Conclusion

The system we describe allows knowledge workers to retrieve information the more closely meets their information needs and delivers in the material in an organizational structure based on document similarity. The systems then allows the user to modify the structure based on their needs and specific understanding of the information, thus providing a personalized knowledge management system.

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Designing a Flow Control Mechanism for Managing Web Resources

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Abstract: Several extensible components based on the Petri net are designed in this paper to analyze and implement a flow control mechanism to manage resources on WWW. With the definition of community, different roles and privileges on Web are divided. An architecture of flow control with a three-tier model is also designed to build such a virtual community on WWW.

Therefore several design issues, such as road map, traversal paths of viewer, login control and visualization, are widely discussed. The flow control architecture involves a flow control daemon that deals with the traversal paths of viewers according to the designed road map on WWW.

Finally, a distance learning system, Internet Virtual Classroom (IVC) is used to verify the flow control architecture under specific purpose on WWW. Because of there are several groups, including SYSOP, Teacher, Student, IvcUser and Guest in a distance learning system can be mapped to appropriate roles in a virtual community. Besides groups even the whole system can be saw as a composite community.

Keywords: *Petri net, community, privilege, resource, flow control, World Wide Web*

1. Problem Formulation

Regarding WWW's open structure, the disordered way with Hypertext Markup Language has been used to catch information on the web. If clients have suitable browser, they can join WWW through the same operation (point then click) without putting those trouble relative instructions, like hostname, password and terminal type. [Hsia97]

The words, images, sounds, movable picture, hyperlink and the combination with FTP, Gopher, WAIS and BBS on WWW would be regards as resource of WWW. And the performance and efficiency of WWW would depend on whether the resource has been used well. Regarding the convenience service offered on WWW and users' various habits and thoughts, there are different group growing. But each group should have different privilege and processed path of each viewer also should be controlled.

Cyberspaces offer people a place for exchanging information freely and communicating with each others no matter they are in the same community or not. All participants in the real/virtual community can share all the information and can be divided into four categories of roles:

1. Manager: like government, charging for making the rules.
2. Supplier: like company, supplying every kind of information.
3. Service-provider: like local education system, offering education, boarding relative information for people.
4. Consumer: like local residents, asking for service.

Similar to virtual community, WWW can be also saw as one sort of virtual community, hence, the roles of participants on WWW can be also categorized to Administrator/Webmaster, Resource Provider and User. The relations and functions between these roles on WWW and community is listed as follows:

Roles on WWW	Function	Roles in community
Administrator/Webmaster	Network and system management	Manager
Resource Provider	Provide resource and reply feedback from User	Supplier

		Service-provider
User	Acquire resource and give opinions	Consumer

Table 1. Relations and functions of roles on WWW

To simplify our resource management problem in virtual community, this paper limits virtual community to WWW environment.

According to the above distinction of roles (or groups) on WWW, each of them has different privileges for accessing resource and different identities for controlling privileges. Mason thought that there are four issues should be taken into consideration when put (or get) information (or resource) into a virtual community: [Mas86]

1. Privacy: personal information for others
2. Accuracy: the accuracy of information
3. Property: owner of information
4. Access: right to get/put information?

No matter which issue is taken into consideration above, all issues involve identity recognition in virtual community.

Since the ambiguous in identity recognition may cause serious social problems, researchers proposed several methods to verify the identity of users in network.[Huan96] After distinguishing the identity is possible, the privilege of viewer on virtual community is controllable. To solve those issues described above by Mason can ensure the efficacy of managing resource on Web.

In order to avoid computer abuse on network, the easiest and effective way is that distinct the limited rights of roles in the network groups. [Har96] It also ensures the WWW resources will be utilized in a reasonable and effective way. Therefore, the usage of system resources for each role is analyzed in advanced and listed in Table 2.

Privileges Roles	R	W	X	Edit	Insert	Delete	Change
Administrator/Webmaster	☐	☐	☐	☐	☐	☐	☐
Resource provider	☐	☐	☐	☐	☐	☐	
User	☐		☐		☐		

Table 2. Privileges for accessing resource on WWW

These privileges shown in Table 2 include R, W, X, Edit, Insert, Delete and Exchange. R, W and X indicate Read, Write and Execution privilege to static resources on WWW usually; Edit, Insert and Delete cause operations in database; Change makes web site provides a whole different resource than before.

Although the roles is categorized and those privileges for different roles are analyzed, viewers still can read resources from one to another through hyperlink on WWW with browsers arbitrarily.[OCHH97] Therefore, this paper proposes a mechanism of managing resource on WWW by using Petri net as analytical tool, is called flow control. Through the flow control mechanism, viewers will be able to get resource correctly according to his/her privileges set up by the Administrator/Resource Provider in previous.

2. Analysis

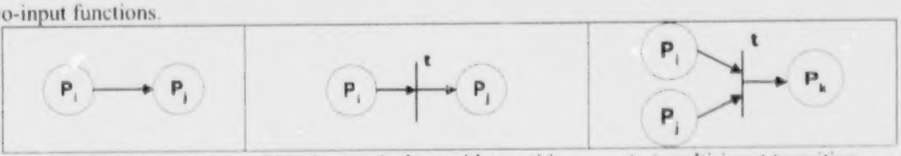
Flow control is one kind of mechanism for controlling process of doing one thing by certain rules. These processes can be treated as a collection of nodes in a graph and the in-between relationships represent their precedence. All of these nodes (places) and relationships are recorded by a directed graph, called *road map*. The flow control references this road map to generate rules for controlling processes. Take routing paths in a city for instance. There might be several paths from one stop to another. A road map records all these routing paths but does not control the precedence from one station to another. This means, a bus can go everywhere arbitrarily according to the road map; therefore, a flow control is needed to limit its traversal path.

A web site involves several pages (or resources), no matter whether HTML pages or even virtual pages created by programs. The hypermedia document graph composed of resources and hyperlinks is similar to road map with several places and many roads in a city. Then its flow control should be analyzed first before the corresponding architecture is proposed.

For the above road map, Petri net is choice as our analytical tool. [PeC81] A *Petri net* is defined as (P,T,A), where $P=\{p_1,p_2,\cdots\}$ is a set of finite *places*, marked by " ", $T=\{t_1,t_2,\cdots\}$ is a set of finite *transitions*, marked by " ", and $A:(P\times T)\cup(T\times P)\quad I$ with $I=\{1,2,3,\ldots\}$ is a group of directed arrows, marked by " ". These arrows in A represent the status that transmits from P to T, or T to P. Note that $P\cap T=\varnothing$ and $P\cup T\neq\varnothing$.

According to the above basic definitions, there is a set of symbols in our analysis model: (1) " " is a place/node, (2) " " represents an event on trigger or a function, and (3) " " is a relationship among nodes. Figure

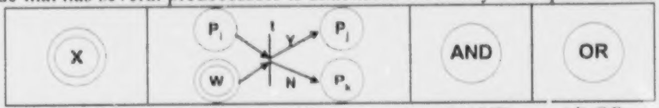
1(a) shows that one place connects another place directly. In Figure 1(b), one place connects another place with a transition. The first arrow means that p_i is an input function of t and the second arrow means that p_j is the output function of t. When it goes from p_i to p_j, transition t is processed. Figure1(c) shows that transition t needs two-input functions.



(a)1 place to 1 place (b)1 place to 1 place with transition (c) multi-input transition

Figure 1. Simple Petri nets

Some extensible components for flow control in virtual community might be needed and analyzed in Figure 2. "□" indicates a specific privilege shown in Figure 2(a), and the character "W" contained in it represents the write privilege in Table 2. Figure 2(b) shows a transition t needs two inputs. t checks if P_i has write privilege or not, and either P_j and P_k will be chose. Figure 2(c) and 2(d) are "AND" and "OR" condition, where "AND" means a successor node which has several predecessors is attachable, if and only if all its predecessors are visited; "OR" means a successor node that has several predecessors is attachable when any of its predecessors is visited.



(a) privilege (b) transition (c) AND (d) OR

Figure 2. extended components for flow control

Based on road map and Petri net, *flow control graph* can be designed in Figure 3. There are arrows (actions/hyperlinks respectively) between two nodes (state/page respectively) in this Petri net graph, which can be used to represent the process of flow control. On the other hand, the arrows are the status that transmits from one place to one transition in Pertri net. The bars among nodes are the mechanism for determining if it could get to the next node. They are the transitions in Petri net. These two kinds of nodes (places in Petri net) are divided into *predecessors* or *successors* according to their positions.

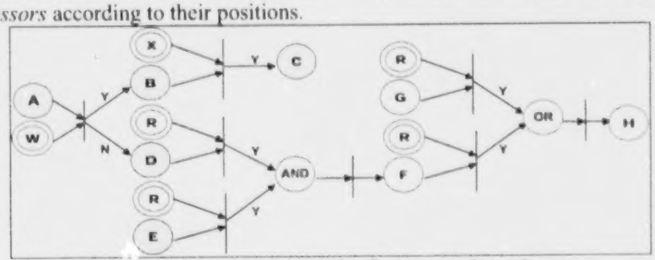


Figure 3. A Petri-net-like flow control graph

Use the flow control graph in Figure 3 as a complete example for detailing the flowing of such graph. Firstly, we take the position from node B, whose predecessor is node A. If node A is visited and privilege of 'W' is attachable, node B is attachable. On the contrast, node D is attachable. Secondly, predecessors of node F are D and E, and there exists an AND condition among nodes D and E. Which means node F will be attachable only when both nodes D and E are visited.

Analysis above just proposes an enhanced analytical tool for hypermedia document graph and its flow control. Since the practical architecture for this kind of flow control is need to design for WWW, more detailed design issues is necessary to describe in the following.

3. Designing a Flow Control System

As analyzed in the previous section, flow control graph is composed of road maps and transition conditions in Petri net. Once the flow control graph is drawn, those predecessors and successors can be found out for each node in graph. The database of flow control graph is possibly created.

For designing a flow control system, several considerations have to be taken. The first issue is how to design tables in database for flow control graph. Table 3 shows the *Road Map Table* observed from the flow control graph in Figure 3. 'ID' is the primary key in this database table, 'Name' is the name of node, and 'Relation between nodes' records its predecessor pages and relationship. 'Group' is the owner of this node. 'Mode' represents that if specific group and others could attend to this node or not.

ID	Name	Relations between nodes	Group	Mode
1	A	0	Consumer	11
2	B	1	Supplier	10
3	C	2	Manager	00
4	D	1	Consumer	11
5	E	5	Consumer	11
6	F	4 AND 5	Consumer	11
7	G	0	Consumer	11
8	H	6 OR 7	Consumer	11

Table 3. Road Map Table for Figure 3

Besides road map and transition conditions, those traversal paths of different users should also be recorded. Therefore, we have to consider two more design issues, including login control and flow control visualization. Since the login control issue is widely solved by some programs, this paper focuses on the *flow control visualization* issue.

In traffic signals, different levels for accessing are indicated with three colors, including red, yellow and green. For Figure 3, since nodes A, B, C, D and E are already visited, *green lights* can be used to represent them, and viewer can move to these green-light nodes with the privilege of that node. *Yellow light* will display at node F to indicate that the viewer has privilege to access but has not entered yet. Finally, node H staying with a *red light* does not allow any access from the current viewer. After a viewer visits the node F, not only the visualization signal of F will change to green but also the signal of H will change to yellow.

Moreover, Table 4 then takes responsibility to record the traversal paths that viewer has visited and what kinds of privilege of this viewer, is so-called *User Log Table*. The array 'Light Signal List' denotes the visualization signal in each page, and need to be used with Road Map Table at the same time. In this array, '1' indicates a green light for a page. For the example of Table 3, '1111100' for viewer 1 represents that the nodes with 'ID' in Road Map Table (Table 2) among '1' and '5' have been visited.

ViewerID	Light Signal List	Is_Manager	Is_Supplier	Is_Provider	Is_Conmsuer
Viewer 1	11111000	0	0	0	1

Table 4. User Log Table

The above database tables in Tables 3 and 4 can be applied to resources (or hypermedia documents) on WWW. For implementing such a flow control mechanism WWW, a server-side-script program (flow control daemon) cooperated with Web Server and database is needed. A three-tier architecture on WWW is proposed in Figure 4, and contains three tiers: *Database Layer*, *Server Layer* and *Client Layer*. Each tier is illustrated and analyzed following briefly:

(1) ***Database Layer***: This layer includes a flow control graph database, where a Road Map Table is transformed from nodes and edges in graph and a User Log Table is used to record the traversal paths of viewers.

(2) ***Server Layer***: This layer consists of a Web Server, lots of resources (hypermedia documents) and at least one server-side program (the flow control daemon). The web server connects Server Layer and Client Layer through HTTP protocol. Server-side flow control daemon responds appropriate resources to Client Layer after comparing the road map in Database Layer. The reasons for using server-side program on WWW are: easy database access, browser independent, source codes security. Of course, server-side program has to work with an appropriate web server. Table 5 lists several kinds of currently wide-used web servers and their corresponding server-side programs.

(3) ***Client Layer***: In the three-tier architecture model, the requirements of Client Layer are simple. Users have not to worry about what kinds of browsers he or she has. Any popular browser works and no additional software nor even plug-in program is needed.

In Server Layer, when resource/document request through HTTP protocol is arrived from Client Layer, web server will transfer this request to flow control daemon to verify privileges for the specific request. While the flow control daemon in Server Layer deals with this resource/document request, the Road Map Table will be dynamically compared to the User Log Table in Database Layer. According to the transition rules in Database Layer, Server

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Layer finally sends a processed document to Client Layer and update User Log Table for recording the traversal paths of different viewers. In the next section, a flow control architecture is implemented and applied to a distance learning system.

Web Servers	Server-side programs
IIS(Internet Information Server)	1. PHP(Person HomePage) 2. ASP (Active Server Pages) 3. CGIs/ISAPIs 4. COM/DCOM
Netscape Server	1. PHP 2. JSP (Java Server Pages) 3. CGIs/NSAPIs
Apache Server	1. PHP 2. JSP (Java Server Pages) 3. CGIs

Table 5. Web servers and their server-side programs

4. Experiment System

Based on architecture of flow control is fully designed in previous section, a distance learning system is implemented to verify in this section. An example IVC (Internet Virtual Classroom) system is set up as a virtual classroom system on WWW. It is "virtual" because it has the effect of a "real" classroom. IVC system is a multi-user and multi-machine CSCW (Computer-Supported Cooperative Work) system. [LCCH99] This system is built on a Web-BBS system at FreeBSD platform (Apache Web Server with FireBird BBS) to integrate their facilities (chat room in BBS and multimedia resource on Web) and the above architecture (login control in BBS and sever-side program on Web).

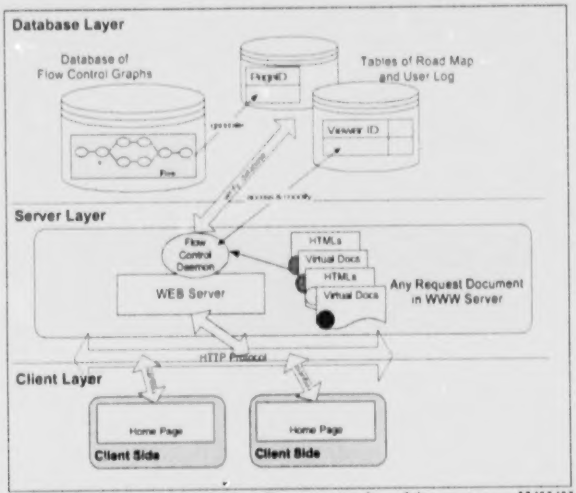
Database Layer
Database of Flow Control Graphs
Tables of Road Map and User Log
PageID
Viewer ID
Server Layer
Flow Control Daemon
WEB Server
HTMLs
Virtual Docs
HTMLs
Virtual Docs
Any Request Document in WWW Server
HTTP Protocol
Client Layer
Home Page
Client Side
Home Page
Client Side

Figure 4. A three-tier flow control architecture on WWW

In IVC, there are some Groups (SYSOP, Teacher, Student, IvcUser, and Guest). The SYSOP represents the Administrator group; Teacher represents Resource Provider group; Student, IvcUser and Guest are User group according to Table 1. The flow control architecture used in IVC to monitor and control the overall privileges of users learning procedures. Details of IVC are described in the other submitted paper.

In IVC, Administrator and teachers can design the road map. The system accesses the flow control information from database, and makes these data become an XML (Extensible Markup Language) file. An XSL (Extensible Stylesheet Language) file is generated to show those pages under flow control with HTML style. And the outlook style of IVC is also dependent on the XSL file. Finally, IVC will have the ability to control the Privilege of user and the learning path of learners with the XML and database. Moreover, according to the road map of learning, teachers can also grant learners the privilege to access a specific page.

Take a real situation on IVC as example, when a learner is reading materials or doing a physics experiment.

IVC controls the learning progress of this learner, and the learner has to read learning material according to the rules set by the teacher or to do physics experiment step by step. If the learner does not obey the rules, the flow control daemon in IVC will not let him or her move to the next step. Figure 5 shows the flow control graph of physics and Figure 6 shows its snapshot.

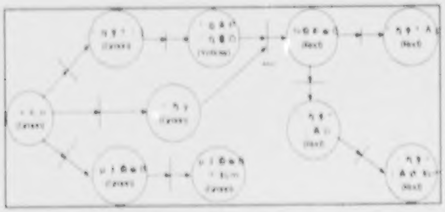

Figure 5. Flow control graph of physics

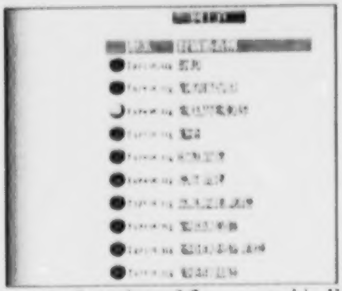

Figure 6. Snapshot of flow control in IVC

5. Conclusion

This paper proposes a flow control mechanism of managing resource on WWW, after different roles and privileges are categorized. With the flow control mechanism, Administrator/Resource Provider is able to set the privileges for different viewers in previous. For analyzing such mechanism, several extensible components for Petri net analytical tool are designed. Detailed design issues are also described for implementing the flow control architecture on WWW. These design issues include database table design (Road Map Table and User Log Table), login control and visualization mechanism. After all these issues are well analyzed and designed, three-tier flow control system architecture is constructed successfully on WWW.

This paper develops an experiment system, Internet Virtual Classroom, to verify this flow control architecture. Teachers can create different road map graph for their courseware in IVC, and the flow control daemon will use the transformed Road Map Table and User Log Table to allow or disallow learners' navigation in IVC. Of course, the flow control is not only can be used in distance education, but also in other applications.

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An approach to collaboration in Learning Environments

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Abstract: Over the last years, there has been a wide discussion about how networking tools such as the World Wide Web will revolutionize education. This has led to the emergence of a plethora of Distance Learning Environments using Web technologies. Unfortunately, these environments have mapped traditional educational approaches to this new medium. CSCW can represent the next step in educational environments creating a richer medium for students and professors and augmenting interaction paths among participants in the learning process. We propose the integration of a full-featured Distance Learning Environment called JLE with a well-known CSCW framework (BSCW) for achieving a seamless model for CSCL. We also assess pedagogical implications considered in the new model.

Introduction

In the last decade, the educational setting has invested an enormous amount of energy and resources to the design of computer-mediated learning environments. However, despite the optimistic view that computers would change the nature of the learning process most environments have mapped traditional schemes to the new medium.

In the traditional Teacher Centered Design, the teacher is the sole possessor of the disciplinary knowledge that must be transferred to students. Consistent with this perspective, almost all classrooms activities revolve around the teacher or the computer as the provider and evaluator of information. Educational environments have mapped these lecture/textbook/evaluation to real-time classrooms (videoconferencing), online contents, and Web evaluation tools. The initial approach of well-known distance learning environments like Lotus LearningSpace and WebCT begun following that line.

A considerable advance in learning models is the Learner Centered Design, that proposes to design learning technology by focusing on the cognitive capabilities and needs of the learner. In this model the role of the professor is more a facilitator and a "guide on the side". In this case individual learning is promoted by playing with the contents, collaboration with other peers is not a critical factor. Most environments have included these ideas and try to provide more active contents with interactive simulations as well as powerful tutorware applications.

At last, a new trend that we could call Group Centered Design goes beyond the learner-centered model and it is based on student learning through constructivism, and collaboration between peers. In this line, CSCL (Computer Supported Cooperative Learning) is an interesting field of research that applies ideas in the CSCW area to the learning process.

In fact, all distance learning environments are now considering the importance of collaboration between students and providing each day more powerful tools. We do really believe that a complete educational infrastructure should provide different pedagogical models and CSCL must be strongly supported in these environments.

In these article we present JLE (Java Learning Environment), an educational infrastructure supporting different learning models. In order to extend collaboration capabilities available in our environment we have integrated the well-known BSCW system as the collaboration module in JLE. In section 2 we present our previous work with JLE and BSCW, in section 3 we explain the overall integration between JLE and BSCW, and we conclude with some remarks to future distance learning environments.

Previous Work

Distance Learning: Java Learning Environment

JLE is a technological environment for the application of virtual training, both by attending classes and by distance learning through the Internet. It reproduces a virtual training environment and provides content publishing and authoring tools (didactic materials, exercises, exams), assessment modules, communication systems (Chat, Electronic Mail, Discussion lists), and progress tracking applications. It is a modular system and is adaptable to educational needs, either in schools or Universities or in a business context. JLE is based on the technical standards established by IMS (Instructional Management System).

The IMS project was created with the intention of defining a specification for the development of the Internet's potential as a training tool. IMS brings academic, commercial and government organizations together so that they work together to achieve a common goal. This goal is to adopt the specifications which allow the educational content and the learning environment shared by various authors to work together. Now the standardization process in the educational setting is mainly driven by international standards committees like IEEE.

Being the IMS specification non-prescriptive --precludes orienting the technical support toward any one pedagogical style or teaching method.-- most implementations and DLEs do not embrace cooperative learning and lack appropriate CSCW frameworks and tools. Nevertheless, all vendors are reconsidering their initial view and are incorporating each day more powerful CSCW tools in order to enable collaboration. The need for supporting rich interactions and exchanges is viewed now as an essential aspect of the learning process. Even self-directed learning programs have some type of interaction between the learner and the body of knowledge or skill sets the learner is trying to acquire. In the workplace, where learning is being considered more of on-the-job performance support versus out-of-the-office training, the rise of groupware tools speaks to the importance of collaboration for ongoing learning.

Pedagogical Assessment/Issues

Being JLE based in the IMS specification it aims to sustain different learning models within the environment. JLE have been applied to a number of University courses with different perspectives; we can found three pedagogical models: professor centered, learner-centered, and group-centered.

In the professor-centered approach, educators tend to copy traditional learning schemes to these new technological medium. The triangle lecture/textbook/exam is simply transferred to the new medium. Professor is still the central point in the learning phase and lectures play an important role in the overall model.

In one course the professor used video cameras and streaming with Real Media Server (included in JLE) for his lectures, he delivered static html content as the online textbook, and he performed exams using the JLE evaluation tool. In the same line some professors have also used JLE as a supporting-tool for traditional lectures. As we can see the pedagogical model has not changed, it has simply moved to a new medium.

In the learner-centered approach, the role of the teacher is often described as the "guide on the side", being more a facilitator than the central access point to knowledge. Interactions with the environment and content are quite important for the learner to understand new knowledge.

This is perhaps the most prevalent alternative being used by DL environments and JLE also provides suitable tools for this scenario. In this case, active content ---like interactive simulations-- is very important for supporting "conversation with the material". JLE also deliver tools for self-progress tracking. At last, Tutorware systems based on artificial intelligence are also very useful for helping student interactions with the material.

As we can see, collaboration and interaction with peers is not central, nor even necessary, from this perspective. Email and newsgroups are enough in this model, since students use these tools to ask questions to the teacher-facilitator. Chat has also been used in these model as a tool for asking questions to the teacher in previously established hours.

Although JLE constitutes an excellent tool in these models, we have found the borderline for its application to more ambitious scenarios like group-centered learning and constructivism. This is also a common problem found in other environments like WebCT and LearningSpace.

In the group-centered model the existing collaboration tools are not sufficient, project-based learning need a more consistent groupware tool with rich interactions and a suitable awareness model. At these point we suggested to our professors the use of BSCW as an excellent groupware tool.

CSCW: BSCW

The BSCW shared workspace system (BSCW = Basic Support for Cooperative Work) is an entirely Web-based groupware system that provides document management facilities and supports self-organizing groups. Based on the metaphor of 'shared workspaces' users can access online-repositories for documents and other data using an ordinary Web browser. Workspaces are subject to access control and thus can only be accessed by registered users that are members of the according group. Authentication is realized on a username and password level. For more details on BSCW see [1].

Besides several document management facilities such as search, version management and document conversion, BSCW also supports asynchronous awareness features. Each user interaction (document creation, modification or read access) is stored in an object-based event history and is indicated to all group member upon the next login.

Furthermore, BSCW aims to be a generic CSCW framework for the World Wide Web providing integration with existing collaborative tools. As such, it provides integration with email and a number of Videoconferencing tools. They also provide some asynchronous tools like Web discussion forums and synchronous tools like chat and messaging. As a well-known CSCW environment BSCW provides a seamless awareness model, different interaction capabilities and it is thus ideally suited for group work using the Web.

Because of its generic and flexible approach BSCW has been successfully applied in different settings. In the educational arena, BSCW has been widely used for promoting group work among students. Project-based learning is an immediate application of BSCW in educational environments because encourages and facilitates interactions among participants. BSCW is not however a perfect environment for distance learning and it lacks some important features in the learning medium. In the literature, BSCW have been criticized [7] by lacking important concepts like fine-grained monitoring, tutor ware tools, professor and students roles, progress tracking, as well as content publishing and authoring tools. This is natural since BSCW has not been designed taking into account the learning process.

In next section we will explain how the integration of BSCW with a complete DL environment can overcome these deficiencies found in BSCW when applied to the educational setting. In our view many existing instructional management systems may be considered an applied use of groupware technology extended with suitable educational components.

The proposed model: JLE + BSCW

As a direct consequence of our previous work -- the application of JLE and BSCW to the learning process-- we are integrating both environments in order to create a suitable framework. This is not however a simple task neither in the design aspects nor in the pedagogical models involved in the integration. In one side, there exists some duplicated functionality that arises in the integration phase, in the other side it is not possible to just blend different pedagogical models. We will explain how encompass best features of both environments in order to solve these obvious clashes.

Concerning the possible integration of JLE and BSCW two approaches can be taken: BSCW as the collaboration module of JLE or instead BSCW extended with JLE's educational components. We think that both alternatives have benefits and problems and we plan to support both lines of research. In the last one, we are working with GMD-FIT in order to extend BSCW for educational settings. In the other side we are developing an hybrid approach trying to provide a seamless integration of BSCW as the collaboration module of JLE.

Overall Architecture

We have paid special attention to several modules due to their special importance in the architecture:

- User/Group Management
- Interface Design
- Event Tracking
- Component Integration

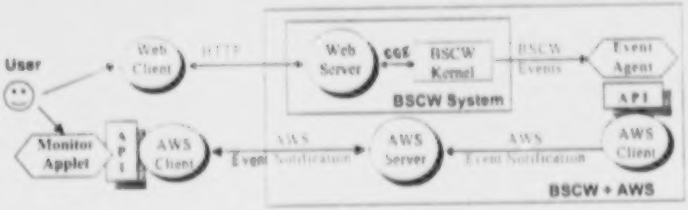
The **User/Group Management** is an important module, since both environments provide duplicated authorization and authentication mechanisms. BSCW uses HTTP basic authentication and a proprietary user database. For authorization BSCW groups map to folders--workspaces-- and they also provide a powerful access control list scheme. JLE also has its own proprietary user database along with custom security mechanisms and group membership. The ideal integration would be to map both approaches to a public directory like LDAP in order to centralize user/group management. This is however an expensive and costly solution so we opted for a more realistic one.

Our solution consists on interfacing the BSCW user/group administration from the JLE environment. For example, the creation --action-- of a JLE user will imply the creation of the same BSCW user. In an analogous way, the creation/deletion of a JLE group will provoke the creation/deletion of a BSCW workspace with the specified group members. Authentication has also been integrated in JLE in order to avoid an unnecessary login phase. Although this approach implies an inherent duplication of functionality, it is an straightforward solution that provide a seamless environment. In this case JLE students will observe a direct mapping of their group membership in JLE to BSCW workspaces in the collaboration area.

Nevertheless, users still face a big clash in the **interface design** of both environments. It is a main requirement of our integration work to accommodate the BSCW user interface in the JLE environment to achieve a smooth gap between both environments. This is not however a very difficult task because the flexible user interface personalization and customization features of BSCW are ideally suited for this integration phase. Our interface experts are working in a coherent and seamless interface with the main goal of avoiding clashes and making users feel comfortable with the complete environment.

Another important issue we must take into account is **Event Tracking**. The existence of a powerful Event Service is important as an information bus for several applications like system monitoring, information retrieval, and tutor ware systems. Although both JLE and BSCW provide their own event systems, the integration is quite simple and elegant due to the clean architecture of BSCW.

In BSCW there exists an Event Agent that is responsible of sending events to several event services. In their case the agent redirects BSCW events to a built-in event service called AWS and to the more powerful NESSIE notification system.



This clean –and thread-safe-- point for redirecting events is ideally suited for our architecture. We only have to add a redirector to the Event Agent in order to send BSCW events to the JLE notification service. Our monitoring tools and tutorware applications will thus be able to study and keep track of students interactions inside the BSCW system.

Perhaps a more delicate problem is how to integrate JLE **educational components** in BSCW. We are working with GMD-FIT in order to make components --like content authoring, evaluation tools, and others-- to become first class BSCW objects. However, in our initial approach most of these modules are used in the JLE context, being used BSCW (collaboration area) mainly for augmented interaction and project-based learning.

As a result of our work, the integrated environment provides the following services :

- Data Management (i.e. relational or OO databases)
- Basic Asynchronous Communication (i.e. e-mail, discussion lists and news services)
- Advanced Asynchronous Communication (i.e. media on demand)
- Basic Synchronous Communication (i.e. Chat rooms)
- Advanced Synchronous Communication (i.e. video-conferencing)
- Collaboration Support (i.e. Shared WorkSpaces)
- Management of digital Curricular Materials Repositories.
- Support for student Tutoring, Tracking and Assessment.
- Support for Authoring and integration of existing materials.

The **pedagogical implications** of the resulting system are straight forward: JLE now provides a generic tool supporting different pedagogical styles or teaching methods. The borderline that we found in JLE when trying to apply CSCL techniques is clearly fulfilled in the new model. We are therefore providing a more suitable tool for learning in the net using advanced technologies.

Conclusions & Future Work

The confluence of different fields like Multimedia, Artificial Intelligence, CSCW, CSCL, HCI, and others can create the perfect framework for active learning. We aim to apply these advanced services in order to create a powerful framework for educational settings.

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After our previous work with our own learning environment we found some limitations in the collaboration module that limited our ability to apply CSCL and project based learning in University courses. Finding the BSCW groupware system very suitable and after its pervasive use in some courses we decided to integrate it with our platform and thus providing a more complete environment.

We have created a complete environment achieving a smooth integration of both platforms and thus enabling new pedagogical learning styles. It is our work now to test the new integrated environment with existing courses and real users. Feedback received by students and professors will be decisive for polishing existing defects of the overall platform.

We also plan to apply new collaboration tools like 3D and more situated spaces, artificial intelligence for data-mining (detecting students with learning problems), and the creation of interactive simulations focused in group learning and social interactions.

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Acknowledgments

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Developing Web Browser Recording Tools

Using Server-Side Programming Technology

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Abstract: It is always a challenge to present Web applications at a facility with no Internet connection. Traditional presentation methods such as transparencies or slides are inadequate for demonstrating dynamic Web applications. Currently, virtual-live demonstrations of Web applications are created with static HTML (Hypertext Markup Language) files. However, preparing such presentations is tedious and requires much manual labor for downloading HTML and other files and modifying them for proper linkages. Demo Server (DS) is a tool that automates this process. Developed using Java Servlets and Apache Web Server on the Sun Solaris platform, DS records various types of browsing activities and saves a set of HTML files for presentation automatically. This paper addresses both system level design concepts and key technical implementation details.

1. Introduction

Even as the Internet becomes popular in research, commerce, and daily life, many places still do not have the infrastructure for connecting to the Internet. Presenting Internet applications in such places becomes challenging. A common work-around is to access a set of static and locally stored HTML files through a Web browser.

A great deal of work is involved in preparing files for such canned demos. Initially, a scenario is sketched, the site is browsed, and all pages are downloaded and saved as HTML files. All hyperlinks and HTML action attributes must be modified and tested in all of the HTML files. Moreover, all image and JavaScript files need to be downloaded for accurate display. Finally, all URLs (Uniform Resource Locator) need to be inspected. The entire process must be repeated each time the scenario is modified. Clearly, such an approach is tedious and not cost-effective.

Demo Server (DS), an Internet browser-recording tool, has been developed to automate the process of creating interactive demonstrations of Internet applications without a live connection to the Internet. DS uses server-side programming (Java Servlets), is a Web based browser independent tool.

At the beginning of a session to create a presentation, DS uploads the page at the URL provided by the user. DS then records all browsing activities, uploading information from each page. Users may stop and download their recording at any time by clicking on the appropriate links. Each HTML file is named as Px.html [1], where P0.html is the starting page. To begin the presentation, users simply load P0.html in their Web browser.

2. System Architecture and Components

Three major components are implemented in DS (Figure 1): a GUI (Graphic User Interface), a proxy server, and backend modification functions (i.e., parsing functions).

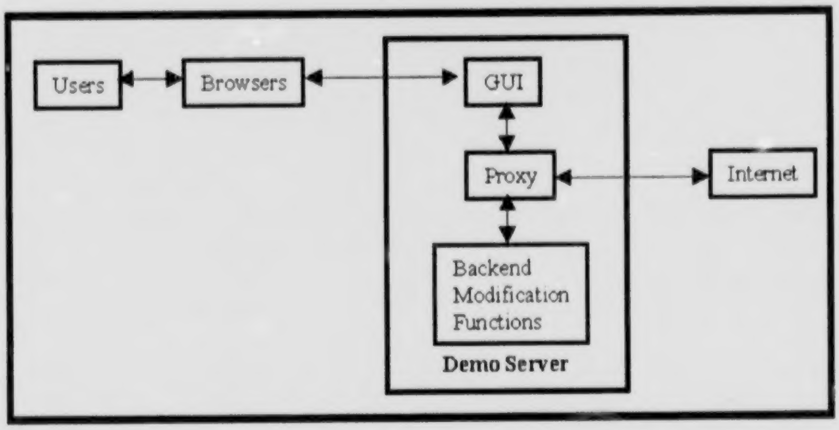


Figure 1: System Architecture and Components of Demo Server.

Users interact with DS through HTML forms via Web browsers. The GUI component provides three major functions. First, it provides a starting point for users to submit the URL and begin a recording. Second, a recording screen displays the Web site that users are browsing and provides a stop button. Third, a final page allows users to save and download recorded files.

The proxy server is the core component linking the GUI component and backend functions with the Internet. As a user starts a recording, the proxy server reads in the URL given by the user from the GUI and then establishes a connection to retrieve contents of the Web site. The proxy then examines the retrieved contents for images or non-embedded JavaScript in the page, automatically downloading the required files from the site. It also keeps track of the current page number during recording, reads and writes HTML content from and to the DS server hard drive, and compresses files for users to download.

The backend component is essentially a parser that searches for and replaces certain strings in the HTML files. In other words, it looks for specific HTML tags and changes the tag's attributes. Three major functions, `modify-1()`, `modify-2()`, and `getImageList()`, are implemented in the DS backend component as described below.

---

[1] x starts from 0 and increments by one for each page recorded. For example, if four web pages are recorded, there will be the following four HTML files: P0.html, P1.html, P2.html, and P3.html.

`modify-1()` is called when the proxy server gets Web site content from the Internet and displays it to users in the GUI component. Its main purpose is to modify hyperlinks and forms attributes so that retrieved page will access the DS proxy when users click a hyperlink or submit a form. In addition, source attributes of images and non-embedded JavaScripts are modified by this function. Please refer to Section 4 for technical details.

`modify-2()` is called at the end of the recording session and changes the `href` and `action` attributes of hyperlinks and HMTL forms in all saved pages to reference itself for all links and forms not clicked or the next page for those that are clicked/submitted [2]. Furthermore, `modify-2()` changes URLs of all images and non-embedded JavaScript files to reference the appropriate directory.

Another function in the backend component is `getImageList()`, which retrieves `src` attributes from `image` and `script` tags in all HTML files and saves them into a list. DS calls this function to download images and JavaScript files from the Internet after `modify-1()` is done.

3. Software Logical Procedures

There are two procedures for operating DS: start and stop recording. Users start recording their Web browsing activities by submitting the starting URL. DS displays the content of the starting page in a separate frame in the lower half of the browser (see Figure 2). However, all subsequent requests go through the proxy component. Users then move to a new page by clicking on a hyperlink or submitting a form while browsing the Web in the lower half of the GUI component. DS repeats the process for every new page (i.e., downloads files from the Internet and modifies them). When users click on the stop button, all modified pages are downloaded from DS to their local computers. The logical steps are summarized below. See Figure 3 for a schematic diagram of the start-recording process.

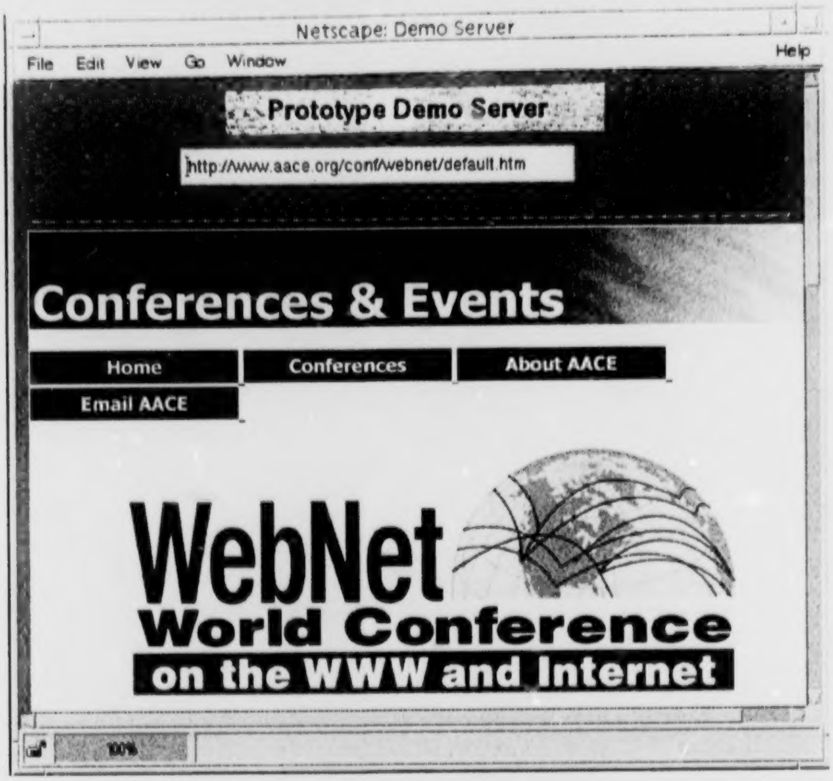
- **Logical steps for start-recording:**
  1. Users type in the first URL to start the recording.
  2. DS sends out a request to the first Web page. At the same time, DS keeps track of all requests for final modifications.
  3. DS downloads the content of a designated Web site, including images and non-embedded JavaScript files from the Internet.
  4. DS calls `modify-1()` to process the HTML content.
  5. DS saves the modified file to its hard drive. Each downloaded file is named Px.html where x is the current page number.
  6. DS displays the modified HTML file in the browser.
  7. Users move to a new page by clicking a hyperlink or submitting a form on the current page. Repeat steps 2 to 7.

The logical steps are summarized below and a schematic diagram of stop recording is shown in Figure 4.

- **Logical steps for stop-recording:**
  1. Users send a stop command to DS by clicking on a stop link.
  2. DS calls `modify-2()` to perform the final modification on all saved HTML files.
  3. `modify-2()` reads files from the DS hard drive and modifies them.
  4. DS saves all modified files and compresses (tar) the entire directory.
  5. The compressed files are downloaded to a user's computer upon the user's request.

---

[2] The proxy server component keeps track of URLs of clicked hyperlinks and submitted forms in all pages. At the end of recording, this information is passed back to function `modify-2()` for final modification.


Netscape: Demo Server
File
Edit
View
Go
Window
Help

Prototype Demo Server

http://www.aace.org/conf/webnet/default.htm

Conferences & Events
Home
Conferences
About AACE
Email AACE
WebNet
World Conference
on the WWW and Internet
100%

Figure 2: An illustration diagram for Demo Server.

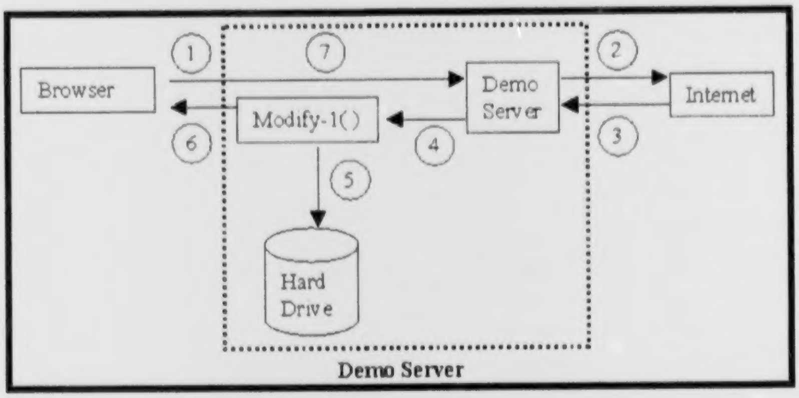

Browser
① ⑦
Demo Server
② Internet ③
Modify-1()
⑥ ④
⑤
Hard Drive
Demo Server

Figure 3: Schematic diagram for start-recording procedures.

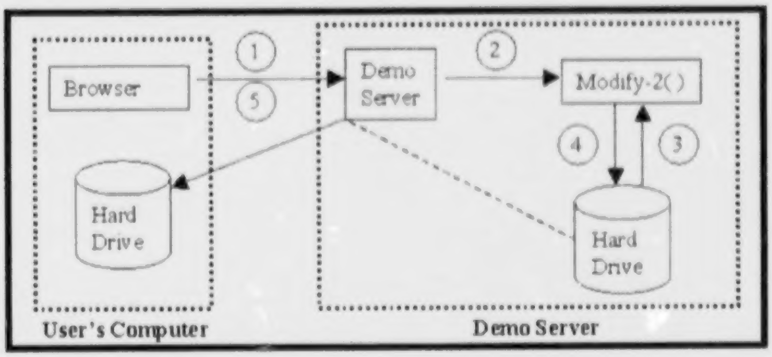


Figure 4: Schematic diagram for stop-recording procedures.

4. Examples and Technical Details

A server-side programming technique, Java Servlets, is used for implementing DS. The Java classes, `HttpURLConnection` and `URL`, are used to get contents from a given URL and download image and JavaScript files. After the first page is displayed, users move from one page to another by either clicking on a hyperlink or submitting a form request. Thus, the key design issues of this tool are handling 1) image and JavaScript files; 2) hyperlinks, and 3) HTML forms. In examples given below, "`dsUrl`" and "`realUrl`" represent the URL of the DS and that of Web site destinations on the Internet, respectively.

- **Image and JavaScript files:**
  Images and JavaScript files are handled similarly. Thus, we use image files as an example to illustrate the process. An HTML page that includes an image will have the tag `<image src="http://realUrl/image.gif">`. DS calls function `modify-1()` to change it to `<image src="http://dsUrl/image.gif">` and then displays the page. Users are therefore able to see the image in the DS-modified Web page. After users stop the recording, DS calls `modify-2()` which changes this tag to `<image src="image.gif">`. In this implementation, all image files along with HTML files are stored in the same directory for users to download and replay.

- **Hyperlinks:**
  As discussed in Section 2, all hyperlinks on a page need to be modified before DS can display the page since all linking activities go through the DS proxy component during recording. For example, if the current page number is 2 [3], the tag `<a href="http://realUrl">` is changed to `<a href="http://dsUrl?Page=2&realUrl=http//realUrl">` by `modify-1()`. With this modification, the DS proxy component is able to parse the content of this hyperlink and retrieve the current page number and the URL of destination page when users click on this link. A final modification is performed by the `modify-2()` function after users stop the recording: The hyperlink becomes `<a href="p3.html">` if this link is clicked and `<a href="p2.html">` if it is not clicked [4]. Thus, users may move from page 2 to page 3 by clicking on this link during replay.

---

[3] DS keeps track of the page number through the Java Servlets Session function.

[4] If the hyperlink is not clicked during the recording, the link points to itself. This implementation provides a nice feature for users (e.g., incases where a presenter clicks a wrong link by mistake during the presentation).

- **HTML Forms:**
  HTML forms are the most complicated cases that DS must handle. For the same reasons as hyperlinks, forms need to be modified before DS displays it to users. For example, if the current page is 2,
  `<form action="http://realUrl" method="POST">` is changed by `modify-1()` to

  ```
     <form action="http://dsUrl" method="GET">
     <input type="hidden" name="realUrl" value="http://realUrl">
     <input type="hidden" name="Page" value="2">
     <input type="hidden" name="isPost" value="yes">
  ```

  With the above modifications, DS is able to retrieve information from the destination Web site from the Internet, a page number, and a boolean value of isPost [5]. DS reformulates the query and sends a new request to the URL of the Web site while users submit this form to DS. Finally, DS modifies this form again by calling `modify-2()` after users stop the recording. The final modifications is
  `<form action="p3.html" method="GET">` if this form is submitted and
  `<form action="p2.html" method="GET">` if it is not submitted.

5. Summary and Future Work

DS is a powerful, cost effective, and easy-to-use tool for users to record and replay Web browsing activities during interactive presentations of Internet applications where no connection are available. It is easy to use and implement. However, there are some issues that need to be addressed to enhance the tool.

DS was originally developed for NLM to present a specific Web site as an interactive "canned" presentation (`"http://clinicaltrials.gov"`). All HTML files at this site are automatically generated by computer and the syntax is thus very consistent. Realistically, many Web sites on the Internet have inconsistent and even malformed HTML syntax. Currently, DS cannot handle such Web sites. A more sophisticated parsing algorithm is needed to make DS a more generic tool. Besides, the current design of DS assumes all image and JavaScript files have different file names. In addition, DS is currently designed for a single user. Further design modifications are needed to address these issues and incorporate new features into this tool.

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[5] A Boolean flag, isPost, is used in DS to reformulates (when the value is true) the query by adding variables, such as Page, realUrl, and isPost, to the original GET request.

Conventions for Knowledge Representation via RDF

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Abstract: The Resource Description Framework (RDF) provides a basic model to describe relationships between objects. Ultimately, it is intended to permit the representation, combination and processing of most kinds of metadata from Web-accessible documents or databases. However, except for representing simple metadata, its current XML-based syntax and the set of basic classes that have been defined are insufficient. To make extensions, the users are required to declare new classes in "schemas" or import schemas from other users. The problem is that similar/identical classes or features will probably be introduced by various users via different names or used in different ways, and this prevents the comparison, reuse and combination of the metadata. To maximize the reuse of metadata, we propose some lexical, structural and semantic conventions, inspired from various knowledge representation projects. These conventions would have to be agreed on and completed by the W3C commitee.

Introduction

The Resource Description Framework (RDF; http://www.w3.org/RDF/) "can be characterized as a simple frame model". It is sufficiently low-level and general for most other knowledge representation models to be translated into. However, since it is low-level, there are many possible ways for such translations, and there are many ways for users to represent the same fact. These various ways are not comparable and therefore, without additional features and conventions, RDF cannot support metadata exchange and reuse. As noted by Berners-Lee et al. (1999), "work is needed to define common terms for [extending RDF to the power of usual knowledge representation systems]".

RDF currently has constructs for representing simple existential graphs plus some kinds of sets, contexts and term declaration. Berners-Lee (1999) proposes some additional constructs for representing universal quantification. RDF users can declare new classes to introduce additional features, and give some constraints (essentially via relation signatures) but no real class "definition" is as yet possible.

A usual concern is that an increase in expressiveness leads to a model and a language too complex to handle efficiently. In actual fact, like other XML agents, the RDF/XML analyzers will exploit some terms (those representing features they know how to handle) and ignore others. Thus, the level of complexity dealt with is not determined by the language but chosen by the user via the selected analyzer. Some applications require the exploitation of rules, sets, logical negation and contexts, whereas simple structure matching may be sufficient for a search engine.

In Section 2, we propose lexical, structural and semantic general conventions, synthesizing conventions from various knowledge representation communities. In Section 3, we propose ways to apply and extend RDF/XML in various logical cases of knowledge representation.

General Conventions

These conventions apply not only to RDF but any knowledge representation language that can be translated into a directed graph model such as RDF. Rather than using RDF terminology, we use the more intuitive terminology of Conceptual Graphs (CGs) (Sowa, 1984). A "concept" refers to a node ("resource" in RDF; it may represent 1 or several objects). A "relation" ("property" in RDF) refers to a relationship between concepts. A "class" refers to a certain kind of concept or relation. An "ontology" (or "schema") is a set of class declarations.

Lexical normalisation

InterCap style For Identifiers

Identifiers in RDF/XML must have legal XML names. The "InterCap style" has been adopted, with a lower case first letter for relation classes – as in *rhetoricalRelation* and *subClassOf* – and an upper case first letter for concept classes – as in *TaxiDriver*.

High-Level Lexical Facilities

To reduce lexical problems and promote metadata reuse, high-level languages or query interfaces should provide lexical facilities for the user. For instance, language analyzers could automatically normalize identifiers that include uppercase letters, dashes or underscores into the Intercap style, as well as exploit user-defined aliases. Such analyzers should also accept queries or representations that use undeclared class names (e.g. common words) when the relevant class names can be automatically inferred via the structural and semantic constraints in the queries or representations and the ontologies they are based upon. When different interpretations are possible, the user should be alerted to make a choice. This last facility, detailed in (Martin & Eklund 1999), is particularly interesting when the exploited ontologies reuse a natural language lexical database such as WordNet (http://www.cogsci.princeton.edu/ wn/): it spares the user the complex (and tedious) work of declaring and organizing each term used. This facility (along with high-level notations and interfaces) seems an essential step to encourage Web (human) users to build knowledge representations. Similar ideas for the exploitation of lexical databases such as WordNet are developed in Ontoseek (Guarino et al. 1999).

Nouns For Identifiers

The convention of using nouns, compound nouns or verb nominal forms whenever possible within representations not only makes them more explicit, it also efficiently reduces the lexical and structural ways they may be expressed.

Concept classes referred to by adjectives can rarely be organized by generalization relations but may be decomposed into concept classes referred to by nouns.

Concept classes referred to by verbs can be organized by generalization relations but cannot be inserted into the hierarchy of concept classes referred to by nouns (and therefore cannot be compared with them) unless verb nominal forms are used. These nominal forms, e.g. *Driving*, also recall the need to represent the time frame or frequency of the referred processes. Additionally, they are in accordance with the use of various kinds of quantifiers, e.g. it is possible to speak about "any abstract_entity" and "at least 3 transformations" but "any abstract" nor "at least 3 transform".

Most identifiers in current ontologies are nouns (e.g. the Dublin Core or the Upper Cyc Ontology), even in relation class ontologies such as the Generalized Upper Model relation hierarchy. Avoiding adverbs for relation names is sometimes difficult, e.g. for spatial/temporal relations. What should be avoided is the introduction of relation names such as isDefinedBy and *seeAlso* (both proposed in RDF). Better names are *Definition* and *AdditionalInformation*.

Singular Nouns For Identifiers

Most identifiers in ontologies are singular nouns. For the sake of normalization, it is therefore better to avoid the use of plural identifiers whenever possible, e.g. by using "distributive sets" (that is by using the RDF keyword "aboutEach" instead of "about" whenever possible).

Structural and Semantic Normalisation

Binary Basic Relations

As with most frame-based models, RDF only has binary and unary relations. Relationships of greater arity may still be represented by using structured objects or collections, or using more primitive relations. For instance, "the point A is between the points B and C" may be represented using the relation *between* and a collection object grouping B and C, or using the relations *left* and *right*, *above* and *under*, etc. Most often, decomposition makes a representation more explicit, precise and comparable with other representations.

Thus, relations should refer to simple/primitive relationships because complex relationships cannot be compared without special rules being added. As a rule of thumb, relations should not refer to processes and should whenever possible be named with simple "relational nouns", e.g. *part* and *instrument*. Complex relational nouns such as child and *d*river imply additional lexical or structural facilities (e.g. those of Ontoseek).

Avoid Disjunctions, Negations and Collections

Representations including disjunctions, negations or collections are generally less efficiently exploitable for logical inferencing than conjunctive existential formulas and IF-THEN rules based on these formulas.

It is often possible to avoid disjunctions and negations without loss of expressivity using IF-THEN rules or by exploiting class hierarchies. For instance, instead of writing that an object X is an instance of *D*irectFlight OR of *I*ndirectFlight, it is better to declare X as an instance of a class *F*light that has *D*irectFlight and *I*ndirectFlight as exclusive subclasses (i.e. classes that cannot have common subclasses or instances). Exclusion links between classes (or between whole formulas) are kinds of negations that can be handled efficiently, and are included in many expressive but efficient logic models, e.g. Courteous logic on which the Business Rules Markup Language (BRML) is based.

The introduction of identifiers for collections may also often be avoided using "distributive collections", i.e. in RDF by using the keyword "aboutEach". Distributive collections are often easy to handle since they can be considered as syntactic shortcuts for representing relations about each of their members. Class definitions describing typical or necessary relations associated with the class instances are also a way of representing facts about collections of objects that knowledge representation systems generally handles more efficiently than if these relations were directly represented using (real) collections inside other assertions.

Precision, Term Definitions and Constraints

The more precise the representation the less chance of conflict with another. The more primitive its components, the more likely the representation can be cross-checked and compared with others to respond to queries. Representations should be contextualized in space, time and author origin. No relevant concepts should be left implicit. The RDF documentation states that for some uses, writing property values without qualifiers is appropriate, e.g. "the price of that pencil is 75" instead of "the price of that pencil is 75 U.S. cents". However, a representation of the first sentence would be ambiguous, not comparable with other prices. This violates the original purpose of RDF.

To improve precision and allow consistency checks, it is important to use precise classes and associate constraints about their use. At least, a signature should be associated to each relation class, and exclusion between classes should be represented.

To improve the retrieval of classes or representations using them, it is important that these classes specialize commonly used classes. One way to do this is to specialize classes from a natural language ontology such as WordNet with domain-oriented classes. Extending such an ontology is often quicker and safer than creating an ontology from scratch, ensures a better reusability of the representations and automatic comparisons with representations based on the same ontology. These issues are discussed and implemented in LOOM (http://www.isi.edu/isd/LOOM/LOOM-HOME.html).

Notations For Logical Cases

We now propose some extensions to the RDF syntax or basic set of classes. Following our conventions, the classes in our examples have WordNet nouns for names.

Simple Graphs: Individuals and Existential Quantifiers

RDF supports the representation of typed individuals, existentially quantified variables, and relations between them. The only extension that seems convenient at this stage is a special relation property (named *dir* for instance) to indicate that the direction of the relation is reversed. Example:

```
E (English): On 12/3/2000, an employee of IBM updated a line of IBM's home page.
RDF: <Company ID="ibm" name="IBM"/>
     <Update><agent><Person><employee dir="-" ressource="#ibm"></Person></agent>
             <object><Line><part dir="-"><File><homePage of ressource="#ibm"></File>
                             </part></Line></object>
             <time>12/3/2000</time>  </Update>
```

Representing the same information without this property *dir* would imply more graphs (smaller ones) or the use of relations such as *part*Of, *homePage*Of and *employer*. To permit comparisons of graphs, these relations would have to be declared as inverse of *part*, *homePage* and *employer*. There is not yet a standard way to do so. If there was, parsers taking it into account would be less efficient.

Contexts

Syntaxically, a context is a concept which embedds other concepts (possibly linked by relations). Semantically, a context represents a situation (i.e. relationships between objects in a real or imaginary world) or a statement (i.e. a description of a situation). As any other concept, a context may be referred to via an individual identifier or an existentially quantified variable. Thus, it is possible to describe relations from/to them and therefore about their content. In RDF/XML, the keyword "aboutEach" must be used to do so.

Some of these relations involve situations, e.g. to situate them in time, while others involve statements, e.g. to state that they have been authored by someone at a certain time. The signatures of such relations is important information for checking or classifying the kinds of contexts connected by such relations. However, explicitly typing contexts with *Situation* or *Statement* to comply with the relation signatures is not intuitive, and it leads to lengthy representations and rather arbitrary decisions. For instance, can logical relations be directly connected to Situation concepts or is an intermediary Statement concept always necessary? This problem has not yet been tackled by the RDF specifications, only one class of context is used: rdf:Description.

We propose that the RDF parsers still accept *rdf:Description* as a generic class for contexts, but automatically deduce their adequate classes (*Situation* or *Statement*) and the implicit intermediate contexts. Even with this facility, the notation for contexts quicky becomes cumbersome and would need to be adapted. The next example shows this need.

```
E:   Tom believes that Mary now likes him (in 1999) and that before she did not.
RDF: <Person ID="Tom"/>
     <rdf:Description bagID="s"><Liking><agent><rdf:Description ID="Mary"/></agent>
                                           <object resource="#Tom"/>
                                </Liking>
     </rdf:Description>
     <rdf:Description bagID="not_s" aboutEach="#s"  truth ="false"/>
     <rdf:Description bagID="p1"    aboutEach="#s"  time  ="1999"/>
     <rdf:Description bagID="p2" aboutEach="#not_s" before="1999"/>
     <rdf:Description aboutEach="#p1"><believer resource="#Tom"/></rdf:Description>
     <rdf:Description aboutEach="#p2"><believer resource="#Tom"/></rdf:Description>
```

In this example, we have represented negation using the relation class *truth*. A better convention might be to use the context class *Negated_description* or simply *Not*. Berners-Lee (1999) also proposes the relation class "truth", plus an IF-THEN construct to allow the representations of rules. Though we reuse this construct in the next section, an alternative is to use relations such as implication or equivalence.
Modalities could be represented via the relation *modality* and an instance of an agreed-on set of modality classes. It is not the purpose of this article to propose an ontology of modalities but we would like to emphasize that for the sake of knowledge reuse such issues should be made part of the RDF standard.

Universal Quantification

BernersLee (1999) proposes a construct for universal quantification. Here is an extract from his examples

```
E:   All members of the W3C can access the member page.
RDF: <forall id="baz" var="x" rdf:about="#x">
       <if><w3c:memberOf>http://www.w3.org/</w3c:memberOf>
           <then><w3c:canAccess>http://www.w3.org/Member</w3c:canAccess></then>
       </if></forall>
```

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Additional properties (e.g. "atLeast", "atMost" and "part") would be interesting to specify some restrictions on the quantification. Here is an example.

```
E:   At least 2% of persons like most of cats.
RDF: <forall id="baz" atLeast="2%" var="p" rdf:about="#p">
       <if><rdf:type resource="#Person"/>
           <then><forall part="most" var="c" about="#c">
                   <if><rdf:type rdf:resource="#Cat"/>
                       <then><objectOf><Liking><agent>#p</agent></Liking>
                             </objectOf></then>
                   </if>
                 </forall></then>
       </if></forall>
```

Such a construct permits the definition of rules on the instances of a class, or in other words, to associate definitions to that class. Without restricting properties (e.g. "atLeast", "atMost" and "part"), the definition specifies relations "necessarily" connected to all instances of that class (that is, necessary conditions of membership to the class). Using **part="most"**, typical relations can be defined, but more precision is achieved with percentages (e.g. **part="75%"** or **atLeast="75%"**).

RDF also permits one to define some restrictions on the use of a class by directly connecting classes via relations. Though this method is convenient for a few well-known special cases (generalization relations, exclusion relations and relation signatures), the semantics of such connections is unknown for other cases. Assume for example that two classes *Airplane* and *Wing* are connected by a relation "part". Does this mean that "any airplane has for part a wing" or "any wing is part of a plane" or "a wing is part of any plane" or "any airplane has for part all the wings"? We propose the first interpretation be adopted (i.e. the source of the relation is universally quantified and the destination existentially quantified).

Collections and Intervals

The properties "atLeast", "atMost" and others such as "size" would also be convenient for containers, and the "forall" construct useful for quantifying over the members of a container. Consider for example the sentence "Ten persons, including Fred and Wilma, have each approved a resolution". Since the persons may or may not have approved the same resolution, an existential quantifier must be used with an existential quantifier within to refer to the resolutions. In the following example, we introduce the class *Set* to specify that the members cannot be identical.

```
E:   Ten persons, including Fred and Wilma, have each approved a resolution
RDF: <!-- if p is a person member of the set {Fred, Wilma, ...}
          then there exists a resolution r that has for approver p -->
     <Set rdf:ID="s" size="10">
       <rdf:li><Person rdf:ID="Fred"/></rdf:li>
       <rdf:li><Person rdf:ID="Wilma"/></rdf:li>
     </Set>
     <forall id="baz" var="p" rdf:about="#p">
        <if><rdf:type rdf:resource="#Person"/>
            <memberOf rdf:resource="#s"/>
            <then><exists var="r" rdf:abrut="#r">
                    <rdf:type rdf:resource="#Resolution"/>
                    <approver rdf:resource="#p"/>
                  </exists></then>
        </if></forall>
```

The properties "atLeast" and "atMost" permit the delimitation of intervals. Here is an example.

```
E:   Tom is the creator of 10 to 20 documents, including http://www.foo.org/bar.
RDF: <Set rdf:ID="s" atLeast="10" atMost="20"/>
        <rdf:li rdf:resource="http://www.foo.org/bar"/> </Set>
     <rdf:Description rdf:aboutEach="#s">
        <rdf:type rdf:resource="#Document"/>
        <creator><Person rdf:ID="Tom"/></creator>
     </rdf:Description>
```

This last example could also be represented using the relations *minimalSize* and *maximalSize* which are part of the 120 basic relations of our top-level ontology. However, like conventions, if such common and basic relations are not adopted as standards, the comparison of RDF metadata (and therefore their retrieval, merge and reuse) will remain problematic.

Conclusion

Information can be represented in a number of different ways, especially with low-level general languages such as RDF/XML. For representations to be automatically comparable, conventions must be followed. We have proposed general lexical, structural and semantic conventions, then examined some issues associated to the most common logical cases and proposed ways to use RDF in those cases. More issues need to be tackled and incorporated into the RDF specifications before this language can support knowledge reuse.

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Multifaceted Approach to Designing an Online Masters Program

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Abstract: Educational institutions are racing to move from conventional classrooms to online delivery of courses and learning materials. In many cases, the process of migration from the classroom to the web is simply taking the form, format and content of the traditional teacher-centered model and delivering it electronically. In one university program, however, the faculty and administrators made a conscious effort to take a broad, extensive approach to designing and implementing a fully online masters program. This approach was centered in a comprehensive needs assessment model and sought input from students, faculty, industry leaders, technical specialists, and other stakeholders. In addition to focus groups of students and industry professionals who might be expected to hire program graduates, .a Delphi process was developed and used with College faculty and administrators as a key element for the clarification of goals, expectations and objectives for the entire program, courses and student competencies.

The Perceived Need

The Conrad N. Hilton College of Hotel and Restaurant Management is generally regarded as one of a handful of top programs in the world which prepares people to become managers in the hospitality field. The College was established in 1969 to meet the demand for professional training in the increasingly complex hospitality industry. To satisfy this demand, the college seeks to prepare students for effective and profitable management roles in their choice of careers and to offer a cultural experience that will aid them in taking their places as productive members of society.

Hotel and restaurant management requires a diversity of skills found in many disciplines including accounting, computer science, economics, law, mathematics and psychology. For this reason, the college emphasizes broad information skills, flexibility in abstract problem solving and in-depth studies of specific skills. The curriculum is designed to prepare students to cope with changing business conditions and to present both theoretical and practical approaches to the diverse needs of the hospitality industry. In support of this goal, faculty members are selected from appropriate academic disciplines and from the professional community on the basis of their knowledge, teaching skills, and practical experience. The field is among the largest in the world, is one of the fastest growing industry sectors, and has a global reach. The College has attracted a significant proportion of its student body from outside of the United States. At the same time, the dean and some College donors have recognized that opportunities for serving significant new markets could be seized by reaching beyond the campus classroom by developing and offering an effective distance learning program.

The College has been offering distance learning courses by Instructional Television (ITV) in the Houston area with programs broadcast over cable television and through a tape purchase. Tape purchase permits previously prepared classes to be distributed to students without access to the cable, or for students being offered the course at a different time. In both cases, instructors interact with students in an asynchronous mode for discussion, questions, examinations, projects and other assignments. Although the ITV offerings have been popular with students, and have been shown to be effective, the College wished to expand its offerings and to introduce additional program offerings and flexibility by making courses and degree programs available online, to be delivered through the Internet. The first program selected for full online delivery was the College's Master of Hospitality Management program. This degree offering is particularly aimed at persons who are at work in the hospitality industry, who have an earned bachelors degree, and who wish to acquire additional management knowledge and skills to progress to more responsible and remunerative jobs in hotels, food service, or other hospitality management sectors. These students would seem to be geographically dispersed, unwilling to leave their current jobs to pursue an advanced degree, and relatively facile in the use of computer and information technology. Thus an online degree seems to effectively meet these needs.

The Challenge

As the College sought to develop an online program, many types of questions arose. Those questions related to the appropriate technology to be used, the design considerations in course development, the ways in which the course are to be taught, the kinds of subject matter and content, and even the fundamental question as to whether "traditional" delivery methods and modes were to be used. To begin to answer some of those questions, and to begin to develop an overall approach to the program concept, assistance was sought from several viewpoints: current students, industry leaders, and members of College business advisory groups. Focus groups were conducted with industry experts, and with groups of students who had and had not participated in College distance learning programs. The student-centered focus groups helped to identify features to enhance the learning processes and the industry-centered groups helped to focus on curricular and program content issues.

The Delphi Process

With the data at hand, it also became evident that a clear consensus and agreement on program outcomes among faculty members was required. The faculty of the College represent a very diverse group with respect to teaching areas, technology expertise, comfort with different teaching and learning strategies, and educational background. The problem was to motivate the faculty to agree on goals for the program as a whole, courses within that program and competencies for the students. Consensus by all faculty was the goal, because consensus is more likely to result in implementation than if resolutions are imposed (Likert, 1967; Ouchi, 1981; Peters & Waterman, 1982). In addition, different faculty held varying definitions of "online," "distance," "distributed," "learner-centered" and other fundamental concepts. To clarify those issues, and to seek consensus among faculty members, a Delphi process was utilized.

The Delphi process may be characterized as a method for structuring a group communication procedure so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem (Linstone, 1975, p.3). As with the oracle at Delphi, an intermediary, in most cases a questionnaire or survey, is used to maintain the anonymity of responses and avoid the bias of dominant individuals. The Delphi process achieves statistically derived group consensus by having a group, in this case, the faculty and administrators of the College, complete a series of questionnaires (Helmer, 1966). Each series, or round as they are called, provides feedback from the previous one. There are usually three to four rounds that culminate either in consensus for each item or no consensus and stability.

A modified Delphi Technique was chosen as the research methodology for this study because of several factors. It was selected because first, the problem of determining goals for a program does not lend itself to precise analytical techniques but can benefit from the subjective judgments of a group of experts, in this case the faculty and administrators of the College. Answers can be vague, subject to many interpretations, and thus cannot be found simply by sifting through relevant information (Pill, 1971; Helmer, 1966; Linstone & Turoff, 1975).

Second, the Delphi Technique is a common method to use in situations where goals are to be identified (Dixon & Henkelman, 1991). In addition, Finch (1993) states that "the Delphi Technique enables experts to speculate individually and then reach consensus collectively regarding the content necessary to prepare workers, even in areas where no workers exist at the present time" (p. 156). Third, the group of experts needed to contribute their opinions to this study has constraints on their relationships that are imposed by tenure, academic rank, and perceived relationships in regard to power. In addition this expert group has limitations on meeting times, and interacting in a face-to-face exchange may not be the best and most productive means of gathering input (Helmer, 1966; Linstone & Turoff, 1975). The Delphi Technique represented the most economical and cost efficient method of soliciting expert opinion and arriving at group consensus on the issues since participants may submit their answers at their convenience without assembling the entire group at a given time.

Fourth, since the responses of the participants in a Delphi survey are anonymous to the others, there are no bias of leadership influence, face-to-face confrontation or group dynamics (Smith, 1976). This anonymity offers a distinct advantage for all respondents; it can offset a domineering personality, fear of losing face by bringing up original ideas, and difficulties in publicly contradicting individuals of higher rank (Dailey 1990) and enables respondents the opportunity to be more thoughtful and creative (Finch, 1993). Each participant has an equal chance to answer. In addition, it is expected that the procedure itself will provide the participants with the opportunity to clarify their own thinking. Therefore the Delphi Technique appeared to be the best way of structuring communication among the members of an expert group in order to create what Linstone (1975) called a "collective human intelligence" (p.5) which includes attitudes and feelings.

Methodology

The Delphi technique is a procedure that involves the repeated or iterative consulting with a number of informed persons, usually experts in the field, asking them first to individually generate and subsequently assess a specific number of statements (Smith, 1976). The generation of statements is termed Round One. The responses of all participants are then assembled and redistributed to each participant for Round Two, asking them to rank each using a likert scale. Responses are recirculated to the participants in Round Three, and the group is asked to consider their responses in light of the total responses of the group. In this way the group moves toward consensus on issues until the desired outcome has been achieved. The actual Delphi technique may vary considerably, depending on the situation, but the primary utility is, essentially, that it systematically produces a well-considered and informed consensus of the perceptions and judgments of a plurality of informed persons (Helmer, 1966).

Statistical Interpretation

Because the goal of Delphi surveys is to reach a consensus of opinion, statistics that reflect convergence around the median are used (Holden and Wedman, 1993). In most Delphis, consensus is assumed to have been achieved when a certain percentage of the votes fall within a prescribed range (Scheibe et al, 1975). In order to determine consensus in this study, the quartile deviation was used. The quartile deviation is defined as one-half the interquartile range or the difference between the 25th and 75th percentile in a frequency distribution.

For this study, the measure of high consensus developed by Faherty (1979) was used. Statements that received a quartile deviation ≤.60 were considered to have achieved high consensus. Statements that received >.60 and <1.00 were defined as having moderate consensus, and statements that received ≥1.00 were considered having low consensus. The premise underlying the Delphi technique is that by the final round of the survey, the quartile ranges of the scores for each statement will have diminished to a smaller interval. It is usually asserted that this statistical phenomena indicates a more concise agreement among the participants (Faherty, 1979). The iterative process of the Delphi survey was terminated when consensus of 95% of the panel's responses had been reached.

A goal considered to be "critical" among the participants was one that received a mean score of 5.5 or higher on a six-point scale by the final round. A goal rated "very important" was one that received a mean score between 4.5 and 5.49. A goal rated "important" had a mean that fell between 3.5 and 4.49. Goals that were rated between 2.5 and 3.49 would be rated "somewhat important." Goals were rated "slightly important" if the mean fell between 1.5 and 2.49. Finally any goals whose mean fell between 1.0 to 1.49 were rated "not important."

Round One

Participants were asked to brainstorm responses to the following question, "What are the desired goals for the Online Masters Program for the College?" and email their responses. Ten faculty members participated in this round and generated 78 goals for the program. Duplicates of these 78 responses were discarded, and some were combined to generate three broad areas of goals: program goals, course goals, and student competencies. There were 22 goals for the program generated, 20goals for courses generated, and 23 goals for graduates of the program generated.

Round Two

In Round Two, participants were asked to rate each goal on the following Likert-like scale:

1=Not important, 2=Slightly important, 3=Somewhat Important, 4=Important, 5=Very Important, 6=Critical

A six-point likert scale was selected because a middle rating was not desired. The participants were asked to mark the rating of each goal that they felt best indicates their analysis of importance. Space was provided at the end of each section of the survey for the addition of goals which participants feel might have been omitted. The fact that very few of the participants chose to suggest any additional goals suggests that the first round survey captured the data accurately.

An example of Delphi items for each section of Round Two is presented below:

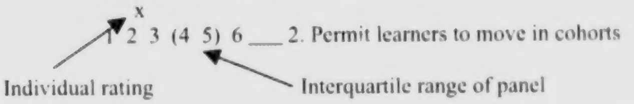
> The Online Masters Degree program should:
> Present materials in an integrated manner from course to course and across topical areas.
> 1=Not important, 2=Slightly important, 3=Somewhat Important, 4=Important, 5=Very Important, 6=Critical
>
> Individual courses in the online Masters Program should:
> Be targeted to mid-career hospitality management professionals.
> 1=Not important, 2=Slightly important, 3=Somewhat Important, 4=Important, 5=Very Important, 6=Critical
>
> At the completion of the Online Masters Program, graduates should:
> Demonstrate competencies in research methods, statistical analysis and writing skills.
> 1=Not important, 2=Slightly important, 3=Somewhat Important, 4=Important, 5=Very Important, 6=Critical

The Round Two survey was given to the participants at a faculty retreat with the instructions to return the completed survey in an envelope as they left. Fifteen faculty members completed Round 2.

Round Three

The results of Round Two were quantified into median and quartile range scores, and two pieces of information for each goal were provided for the Round Three survey: the interquartile range of ratings for the group and the individual participant's rating. Instructions were included with the Round Three survey explaining that the responses of the majority of the participants were denoted by placing numerals in parentheses to indicate the interquartile range, which is both a value and an interval on the continuum. The rating that the individual panel member gave that goal was indicated by an X over the number. An example of this is presented below.

The Online Masters Degree Program should:


x
1 2 3 (4 5) 6 ___ 2. Permit learners to move in cohorts
Individual rating
Interquartile range of panel

Round Three surveys were sent to all faculty members and administrators even if they did not participate in Round Two. Participants were be asked again to rate each goal, noting the item's interquartile range in relation to the panel member's previous rating. No additional goals were added after Round Two. Panel members were allowed a time limit of 7 days to respond to the Round Three survey. Panel members who did not return their surveys by the 4th day were sent personal reminders.

Results of Round Three

Responses from Round Three were analyzed and all statistics, including stability measurements, were computed. The premise underlying the Delphi method is that by the final round of the study, the quartile ranges of the scores for each statement will have diminished to a smaller interval. It is usually asserted that this statistical phenomenon indicates a more concise agreement among the panelists that was true in this Delphi study as well. Of the 67 goals, 64 achieved high consensus by the end of Round Three. The list of goals was prepared with each goal statement listed in order of importance as determined by the mean. The ten highest ranked goals are shown in Table 1

Round 3 Mean	Type of Goal	Statement
5.47	Program	**The Online Masters Degree Program should be world-class, high quality, and recognized globally.**
5.31	Course	Individual courses in the Online Masters Degree program should be learner-centered.
5.29	Course	Individual courses in the Online Masters Degree program should be rich content in which is presented effectively.
5.19	Program	The Online Masters Degree Program should have readily available academic support with timely responses.
5.19	Program	The Online Masters Degree Program should foster, encourage, practice, vision, and apply principles of critical thinking, creativity, and imagination.
5.18	Program	The Online Masters Degree Program should be economically viable
5.18	Program	The Online Masters Degree Program should have a flexible program design to permit frequent revision.
5.18	Course	Individual courses in the Online Masters Degree program should contain adequate intellectual property protections.
5.18	Course	Individual courses in the Online Masters Degree program should present an interesting and satisfying learning experience.
5.18	Course	Individual courses in the Online Masters Degree program should be relevant to student needs and goals, and to job behavior and task skills.

Table 1: Ten Highest Ranked Statements at the End of Round 3

At the end of Round Three, there were no statements that received a mean score of 5.5 or higher which would indicate a "critical" rating, although one was very close: The Online Masters Degree Program should be world-class, high quality, and recognized globally (*M* = 5.47). Fifty-one goals were rated "very important"; these received a mean score between 4.5 and 5.49. Thirteen goals were rated "important" and had a mean that fell between 3.5 and 4.49. Only two goals were rated between 2.5 and 3.49 and were rated "somewhat important." These were: (1) The Online Masters Degree Program should provide a 100 percent placement of graduates. (*M* = 3.35), and (2) Individual courses in the Online Masters Degree program should be taught by teaching teams. (*M* = 3.47) Only one goal was rated "slightly important": The Online Masters Degree Program should not contain a residency requirement as a major consideration. (*M* = 2.18)

Discussion

The Delphi process appeared to function as planned for this study. Even thought the faculty had little or no previous experience with Delphi methodology, the surveys were completed correctly and in the allotted timeframe. The three rounds of the study produced convergent results that appear reliable. Between Delphi Rounds Two and Three, the percentage of statements that reached high consensus increased dramatically, going from 41 statements in Round Two to 64 statements in Round Three. Of this number, 13 statements that previously had low consensus and 9 statements that had moderate consensus moved to high consensus. This change is illustrated in Table 2. There were only two goals that had low consensus, and both had an interquartile deviation of 1: (1) The Online Masters Degree Program should not contain a residency requirement as a major consideration, (*M* = 2.18), and (2) The Online Masters Degree Program should have a face-to-face component, in Houston or elsewhere. (*M* = 3.71)

Based on the results of this study, the College has data that provides a clear consensus among faculty members on most of the program, course, and student goals. It is one tool that will be used to inform a comprehensive needs assessment model, supplement other types of feedback, and can be used as planning guide by College administration. Although the implications of this study cannot be generalized to other colleges, it appears that the Delphi process was useful in capturing and refining a clear picture of current faculty viewpoints and perspectives, and provides a useful method for eliciting faculty opinions and encouraging consensus.

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Program Goals (22 Total)

	High Consensus	Moderate Consensus	Low Consensus
Round 2	15	0	7
Round 3	20	0	2

Course Goals (20 total)

	High Consensus	Moderate Consensus	Low Consensus
Round 2	11	4	5
Round 3	20	0	0

Student Goals (23 – Round Two; 25 - Round Three)

	High Consensus	Moderate Consensus	Low Consensus
Round 2	15	5	3
Round 3	24	1	0

Total for All Goals (65 - Round Two; 67 – Round Three)

	High Consensus	Moderate Consensus	Low Consensus
Round 2	41	9	15
Round 3	64	1	2

Table 2: Consensus on Goals Reached at the End of Round 2 and Round 3

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Facilitating Collaboration, Knowledge Construction and Communication with Web-Enabled Databases

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Abstract: This paper presents an overview of Web-enabled databases that dynamically generate Web materials and focuses on the use of this technology used to support collaboration, knowledge construction and communication. Database applications have been used in classrooms to support learning activities for over a decade, but, although business and e-commerce have quickly embraced dynamic Web-based databases, their potential in educational environments is just now beginning to be realized. The authors explore a social constructivist framework for using Web-based databases to support learning and assessment and describe several specific applications of dynamic databases used to facilitate the construction of knowledge and support collaborative activities in online education courses.

In order to build a true electronic community of learners, communication and collaboration among participants should be considered the driving force. Unfortunately, many online courses (as well as many traditional courses) fail to take advantage of the potential for interactions that can add richness and depth to the construction of knowledge. In our online courses, student homework and projects are often similar to a face-to-face classroom; that is, specific assignments are given and students e-mail it to the instructor to be graded. The problem, we have found, is that student work often does not become part of the course materials, and it tends to disappear at the end of the semester. Consequently, students do not always feel that they are creating or adding to a body of knowledge and information for the course, nor do they experience ownership of the content.

Constructivist Frameworks

Learner-centered, constructivist, and sociocultural theories were used to inform the design, development, assessment and research on Web-enabled database technologies. Our goal is to increase our understanding of the effects of dynamic technologies on student interactions, motivation, empowerment and engagement. Vygotsky's (1978) sociocultural learning theory suggests that learning occurs as learners interact with peers and provides an understanding of learning as a process of social negotiation. The teacher is a co-participant in the learning process and a facilitator in the student's construction of knowledge. Researchers point out that instruction should take place in an environment in which learners use socially mediated and intellectual tools to achieve cognitive development (Rogoff, 1990; Salomon, 1993)

Riel (1998) notes that in the group settings of schools, it is difficult to facilitate engaged learning. She suggests that the majority of time is spent preparing students to learn by delivering information in carefully regulated conceptual units. Students are then responsible for organizing this information in a way that will facilitate easy retrieval at the correct time. Riel suggests that teachers can play a role in providing strategies and tools for creating "intellectual order" (p. xviii). Constructivists favor student-centered methods that support both personal independence and relatedness to the entire group or community. Knowledge construction is a communal enterprise, and the motivation to learn cannot be separated from the social context in which it is embedded. At the same time, constructivists believe that the educational process should nurture each student's own capacity for transformation and self-regulation. Constructivist teaching methods require both collaboration and positive interdependence with other group members and emphasize personal responsibility and individual accountability. (Lebow, 1993). Constructivists support self-regulated learning by promoting skills and attitudes that enable the learner to assume increasing responsibility for the learning itself.

Windschitl (1999) has stated that "constructivism is premised on the belief that learners actively create, interpret, and reorganize knowledge in individual ways." In that vein, we try to create a constructivist environment in our online courses, where students are able to manipulate the content of the course to fit their specific learning needs or goals. To do this, they must interact with the information they are researching and writing about, and they must share their views with the other students in the course, not just with the instructor. In a typical online course in our program area, there may be several hundred postings to the class listserv during the semester. Our efforts, therefore, have been toward having students not only interact with their own small number of postings, but use the virtual environment to explore, analyze, discuss, and debate issues and topics that cover the broad spectrum of information that arises during the course.

Dynamic Databases

Most Web pages, including the course pages that we have been developing for several years, are static and do not take advantage of the interactivity offered by the Web. Most Web pages simply duplicate print-based materials in electronic form. Simply converting existing course information to online format is not enough to effectively produce meaningful Web-based courses. Online course developers must focus on creating courses that are more responsive to students and student needs, facilitating social and instructional interactions, creating a sense of a learning community, and delivering timely and useful information. Creative strategies are needed that utilize innovative tools such as Web database tools are needed.

How a Dynamic Database Works

The integration of Web pages and dynamic database technologies allows users to access a database through a Web page and to dynamically generate Web pages that present the requested data. The variable data on the Web page is generated from the database and delivered to the user through a template page. All of the usual abilities of a database, such as searching for information, doing calculations, entering new information, and editing existing information, are available through the Web browser. This means that any application that can be created using a database can be made available on the Web.

Uses of Databases

Databases are used to facilitate the construction of knowledge and support collaborative activities in online education courses. Students submit assignments for class through an online form that stores the information in a database. Students can check assignment status, grades, and feedback from instructor by logging on to the dynamic site with a username and password. The database may also be used to share assignment submissions with other students. In another instance, student pictures in a database may be automatically added to postings in discussion lists.

Building Community

A database helps builds electronic communities and may encourage students to feel like they belong to a community through shared knowledge. Students may share work with classmates. Pictures of students which come up automatically when posting help students feel less isolated by providing a person to look at when reading the posting.

Potential for Continued Growth

Student work may be easily archived and can be useful over many semesters. Assignments that are already in database provide an example for students who have questions or need more support. The database can expand and evolve easily by building on prior materials. The body of knowledge is not static but continues to change without requiring extra work on the part of the faculty member.

Simplicity and Accessibility

Databases are convenient and simple to use. Students don't need a high level of technical skills in order to be successful. Users do not need to have technology skills to add, revise, or use material in a database since it is driven through forms and search queries. This is particularly important for new or inexperienced users. Even simple forms can be used to collect data and then it may be inserted into a pre-designed template that is always available and accessible from anywhere. Because the database information has the potential to be accessed from anywhere in the world with an Internet connection and a Web browser, data can be expanded, updated or deleted easily. The capabilities to search the database are an important consideration.

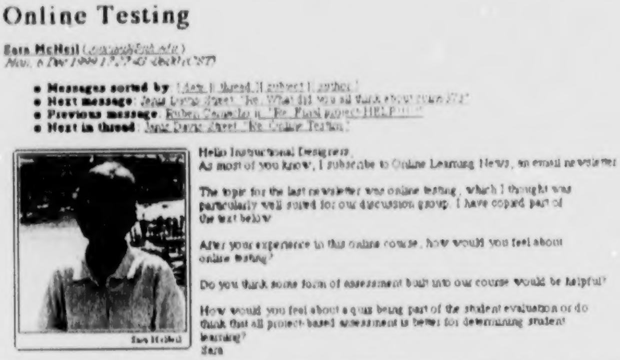
Empowerment
Students may feel empowered because there is immediate feedback on whether submission was successful. Students can check assignment status, grades, and feedback from instructor. This may result in increased interest, engagement, and personal responsibility. There is ownership of the material since the content is collective and not instructor-driven. There is increased interaction between students and the resources. This interactivity implies involvement and commitment, since it empowers the user to control the environment. Empowering students with control of content may affect participation, motivation and feeling of community. Material may become more interesting and stimulating when learner control increases.

Quality
There may be an increased quality of student work because students can see each other's work. Students may feel that they are creating materials for other classes to follow. Class projects may build on work from previous students.

Examples of Dynamic Databases

Example One: Student Pictures and Biographies for HyperGroups

Students in our online classes use a variety of listservs as a primary means of course communication. To enhance the feeling of an electronic learning community, students pictures are taken at orientation and uploaded to the server. When a student posts a message to the listserv through a form that gathers their e-mail address, the message is displayed dynamically with their picture. The student simply has to type in their e-mail address for the picture to appear (See Figure 1).



Online Testing

Sara McNeil ([illegible])
[illegible]

- **Messages sorted by**: [date][thread][subject][author]
- **Next message**: [illegible]
- **Previous message**: [illegible]
- **Next in thread**: [illegible] "Re: Online Testing"

Hello Instructional Designers,
As most of you know, I subscribe to Online Learning News, an email newsletter

The topic for the last newsletter was online testing, which I thought was particularly well suited for our discussion group. I have copied part of the text below

After your experience in this online course, how would you feel about online testing?

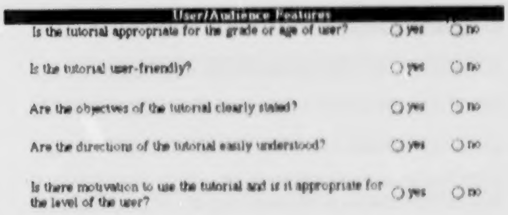
Do you think some form of assessment built into our course would be helpful?

How would you feel about a quiz being part of the student evaluation or do think that all project-based assessment is better for determining student learning?
Sara

Figure 1: Participant's Pictures Automatically Generated by E-mail Address

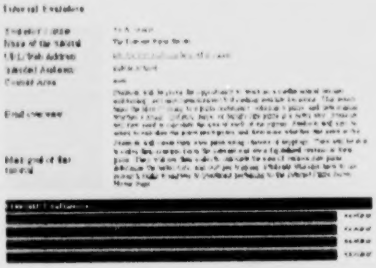
Example Two: Computer-Based Instruction Database

Students in a graduate level instructional design course use the Web database tools to contribute different types of materials. For example, with one assignment, students review an online tutorial and post an evaluation of it using a Web form. They are then able to search the tutorial evaluation database by content area and audience/grade level.



User/Audience Features		
Is the tutorial appropriate for the grade or age of user?	○ yes	○ no
Is the tutorial user-friendly?	○ yes	○ no
Are the objectives of the tutorial clearly stated?	○ yes	○ no
Are the directions of the tutorial easily understood?	○ yes	○ no
Is there motivation to use the tutorial and is it appropriate for the level of the user?	○ yes	○ no

Figure 2: Form Used To Collect Tutorial Evaluation



Tutorial Evaluation

Name of the tutorial
URL/Web Address
Intended Audience
Content Area

Figure 3: Dynamic HTML Page Generated From Database

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Perhaps the most interesting and creative use of a database is the game design assignment. Students design a computer-based game and submit their description as a newsletter article through a Web form.

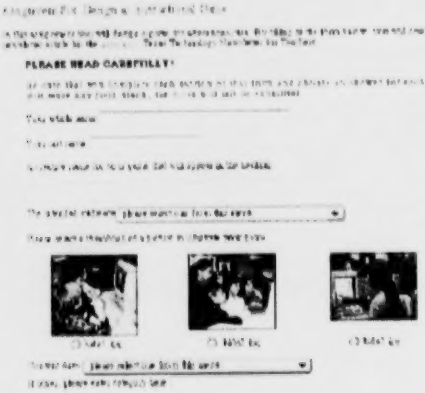
PLEASE READ CAREFULLY!

Figure 4: Form Used To Collect Game Design Data

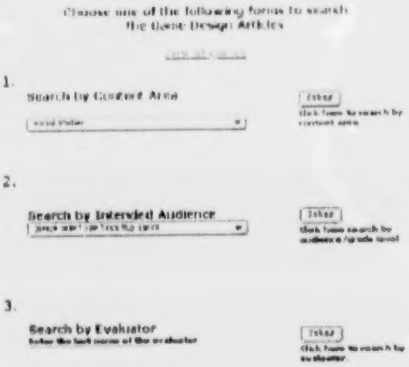
1.
Search by Content Area
2.
Search by Intended Audience
3.
Search by Evaluator

Figure 5: Query Form to Select Game by Content, Audience or Author

Figure 4 illustrates the form used to collect data for the sections of the newsletter. Students use text fields, pull-down menus, and radio buttons to submit information about the game they have designed. When the student submits the data, it is automatically sent to the database. Students may then use the query form (See Figure 5) to search the database by content area, audience, or author. The results of the query by content are shown in Figure 6. Figure 7 illustrates the merger of the content from the database with the newsletter template, the HTX file, which is then displayed in the browser as a dynamic HTML file, complete with banners and graphics (See Figure 7).

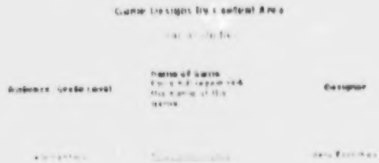
Game Designs by Content Area
Designer

Figure 7: Results of Game Query

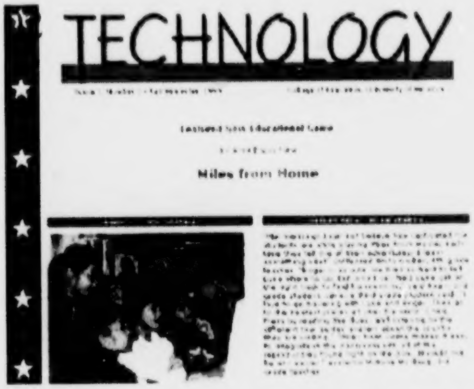
TECHNOLOGY
Miles from Home

Figure 8: Example of Game Design in Newsletter Format

Example Three: Faculty Feedback for Student Assignments

In another online course, submission of student assignments also utilizes the Web database tools. Students are directed to a Web page that contains an online form in which they enter their name, a unique identification number (the last 4 digits of their Social Security number), and the number of the assignment (See Figure 9).

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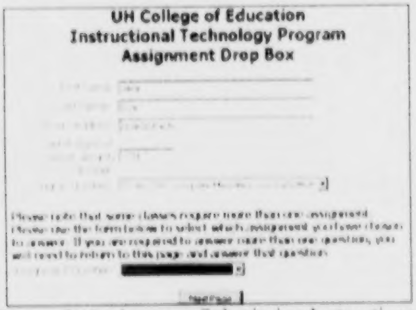
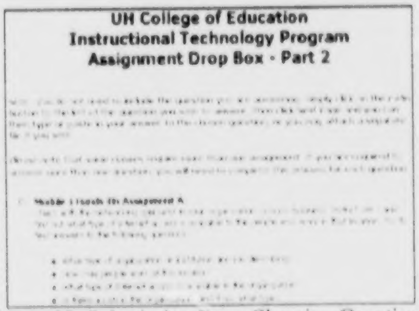


UH College of Education
Instructional Technology Program
Assignment Drop Box

Figure 9: Assignment Submission Instructions



UH College of Education
Instructional Technology Program
Assignment Drop Box - Part 2

Figure 10: Submission Form Showing Questions

Students are then directed to a page where they select from several choices, which questions they will answer for that week's assignment.

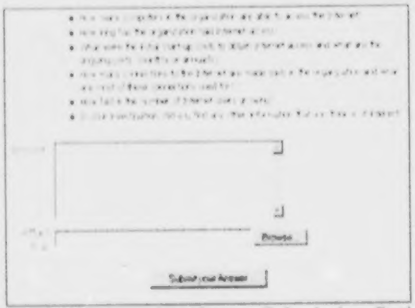
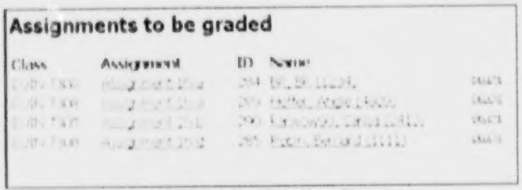


Figure 11: Text or Attachment Submission Options

If they have created a word-processed document, an Excel Spreadsheet document, other formatted document in completing the assignment, an attachment feature may be used. Once the submit button is pressed, the student work is sent to the database and an e-mail confirmation message is automatically sent to the student.

After assignments have been submitted, the instructor uses the Faculty Grading form to provide feedback for the assignments that have been posted (See Figure 12). Since all of the student postings are available in the database, the instructor may review all of a particular student's assignments or all of the other students' postings on a specific assignment, depending on what terms are used to sort and view the database entries.



Assignments to be graded

Class	Assignment	ID	Name

Figure 12: Faculty Grading Form

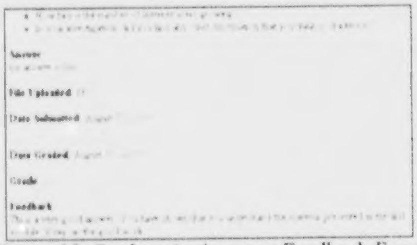


Figure 13: Student Assignment Feedback Form

Students may also view each other's assignments and their own feedback from the instructor by using the Student Feedback Review form. This page includes the question, the answer, and the feedback and grade from the instructor (See Figure 13).

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Potential for Dynamic Databases in Teaching and Learning

Web-based database tools provide students and faculty with innovative solutions that promote collaboration and the creation of shared knowledge. Lynch (1999) summarizes this by stating, "To educational institutions this technology offers a challenge in using the technology to drive a more innovative and acceptable learning environment than that offered by the static Web pages of previous years. What is required now, is the classroom environment to adapt this technology into every day practice."

The use of dynamic database tools has helped us as we seek to improve our online courses, and they have indeed given students greater control over the information covered in the courses. However, there are some limitations that should be mentioned. First, the technical skills needed to develop and use the dynamic database tools are greater than those needed to create traditional Web sites. Many simple HTML editing tools are available, and converting word-processed files, for example, to static Web pages is a skill that may be mastered very quickly. Conceptualizing how the database tools will function is very different from creating static pages, and a new set of skills must be learned that include a greater understanding of information design and management. The time needed to design, develop, and evaluate online courses that include database tools requires a larger amount of both time and patience than many educators will be able to commit. Certainly, as with other Web-related tools, software improvements will make the job easier, but at this time, a steep learning curve is the rule. Finally, students who are asked to interact with these tools will need some instruction on how to use and access the interactive elements.

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Tele-cybernetics:
On Some Necessary Governmental Roles
In the Internet and the WEB

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Abstract. We note three or four national and/or social difficulties being created via the widespread use of the Internet and its concomitant, the World Wide Web, the ethical and legal dilemmas arising because of the intrinsic nature of tele-communications. We use the historical perspective to reveal how these difficulties were essentially resolved within our preceding Age of Printed/Written Communications

In particular, *authentication* and *authorization* are matters which had an equivalence in postmarks and in the return address, respectively. We ask: Where are the certifiable "electronic postmarks" and "electronic return addresses"? ; OR: "Where are *the governmentally-secured* 'electronic post-offices and post-roads' ?"

Furthermore, content-markers are not a foreign concept to the postal service: We delineate procedures by which: copyright protection can thereby be provided; pornographic and obscene transmissions can be highlighted; and, evidence for criminality conducted via *tele*-communications can be collected, yet each obtained without violation of the so-called 'right to privacy'.

The Historical Background

We all seek protection from criminality by vesting (with a governmentally-operated department of justice) the power to collect evidence of transgressions, an activity particularly difficult in our Age of Tele-communications.

Furthermore, we note the difficulty of copyright *protection* in our Age of Digital Tele-communications. Cannot the Library of Congress be authorized to return to each publisher/author the (ONLY) electronically copyright-marked copy of any work submitted to its Copyright Office for the work's copyright registration?

We shall also include a discussion of the protection of *privacy* even though: (A) *content-markers* would be, as in the postal service, a standard operating procedure; and even though (B) electronic file access has been granted to an electronic requestor.

In addition, in the very context of criminality, we note that we tend to overlook the long-established procedure of requiring *content-markers* on the outer wrapper/envelope of a postal despatch. The despatch via the Internet (active) and the despatch off the Web (quite passive) of pornographic, obscene, and even violence-filled messages and images can be considerably curtailed via an "enhanced electronic postmark" which includes standard content-markers, particularly in the context of a nationally-secured and nationally-operated 'Electronic Postal Service'.

Furthermore, a couple of other annoying matters, such as *authentication* (of the true source of a message or transmission) and *authorization* (of permission to enter a computer's accessible electronic files), within our Age of Tele-communications, become quite resolvable when placed in the historical perspective:

We tend to overlook the fundamental story behind Alexander Dumas's (nineteenth-century) historical novel, set in early seventeenth-century France: *The Three Musketeers*. At that earlier time, virtually unregulated roadways and the availability of multiple carriers for the transmission of messages and/or parcels, led to violence and chaos. Furthermore, such social disruptions must have led the American republic's Founding Fathers to recognize as a governmental responsibility the need to "ensure domestic tranquility" [*The Constitution of the United States of America* (1787)].

Indeed, equally overlooked by the typical reader of Dumas's novel is the fact that one of its primary characters is the Cardinal Richelieu (1585-1642), recognized today as the founder/father of the (national) postal service.

We maintain that the historical evidence for requiring a national electronic post-offices-and-post-roads is therefore abundant. Consider, e.g., at this very writing [*USA Today*, 15 February 2000: A1, e.g.], the press coverage of the disruption by a few illicit hackers of several commercial Internet sites.

One should note that we are *not* here calling for a *monopolistic* national electronic carrier. Just as private carriers (e.g., in the past, the Pony Express, and, today, Federal Express) could exist in 'competition' with the national postal service, so should private (and multiple) carriers be permitted in our Age of Tele-communications.

We do propose however, that technologies (such as the electronic/digital watermark) be employed by the governmentally-secured (and -operated) national electronic post office so as to attempt to provide an "electronic sealed letter", the fundamental characteristic, after all, of the national postal service. Such technology would improve considerably on the use of encryption as a (an inadequate) tool to provide such a seal: After all, each success in encryption survives only shortly.

One should note that, if there be multiple (private) carriers, then one day—when perhaps one among them is in dire financial stress—the temptation to intercept/sell (rather than just deliver) messages in order to remain solvent might well prevail.

Of course, the interception of political (and/or national security) messages may not require a strictly *economic* motivation in an environment of multiple carriers: the very message *of The Three Musketeers*.

Tele-cybernetics

We note that the term 'cybernétique' was introduced by the French electrical scientist, Ampère ca 1835, derived from Plato's *The Republic* as "the very art of governing and of deciding in each case not just what can but rather what *must* be done: the art of statesmanship", or scientific politics. We call herein for a "tele-cybernetics", a political science (or, rather, *a scientific politics*) in our Age of Tele-communications.

Interestingly enough, the electrical engineer, N. Wiener tried to claim that, in 1945/6 he had coined the term, "cybernetic" to mean "communication and control in the animal and the machine". His efforts to repeat this claim in a subsequent book of a very political title (*Human Use of Human Beings*) are essentially shameful. Nonetheless, we would suggest that what we require today is a 'tele-cybernetics', one which would also have to mean 'tele-communications plus (proper) tele-controls.'

On File Protection

We propose that the National Electronic Post Office have the sole authority to issue an 'electronic postmark', one which, however, can be easily enhanced digitally to include an 'electronic return address', one which would probably be required by any computer receiving a tele-transmission with a request to access one of the electronic files which it is to protect. Such an 'enhanced electronic postmark' (further enhanced below) could be used therefore to *require* that an electronic return address ['Caller ID'] be provided to the receiving/addressed computer, as well as any other P.I.N.'s or authenticating information (including biometrics) which the receiving computer may demand.

We suggest that, as standard-operating procedure, we all *expect* that such information will/may need to accompany each of our electronic transmissions. We would *know*, furthermore, that the addressed computer will keep a *chronological electronic log-book*, including this particular enquiry of our own. We should thus expect that every receiving computer will keep its own file of the enhanced electronic postmark of every access—attempted or successful-- YET, for files of a personal nature, the person whose files have been requested will be so advised periodically (excepting of course, court-ordered police and/or criminal investigations, though these *might* merely require a threshold of much less frequency).

Privacy and Law Enforcement

This use of the enhanced electronic postmark as an entry in the particular computer's electronic log-book should serve therefore as a protector of privacy, since *every* entry into one's own personally-oriented file (or any particular part thereof) would be recorded, even one from any government official (law enforcement and judicial department enquiries--conducted under court-ordered permits—being excepted, of course).

We seem to be experiencing an expectation that "privacy rights" (see Bork 1997 and Mihram & Mihram 1999) should permit criminal behavior in the sense that *the* governmental authority (Justice)—which must be able to collect evidence in order to prosecute suspected wrongdoers—should be excluded or prevented from having any access to one's computer files. Clearly, a reflection on the role of the Justice Department in "ensuring [our nation's] domestic tranquility" should reign supreme. We must not expect that criminal behaviors, à la those of illicit hackers, should remain undiscoverable.

Copyright Protection

Another of these particular law enforcement issues is that of copyright protection, a constitutionally-mandated duty of Congress, placed by the Founding Fathers so as (explicitly) "to ensure the progress of science and the *useful* arts [emphasis added]", yet therefore another recognition of a true role of government: viz., to ensure domestic tranquility.

The idea that one should be free to copy digitally entire documents (book-length or less) and then distribute these to many others (such as those enrolled in a distance-learning course) probably has emanated from Congress's failure to protect copyright explicitly in law once the xerographic technology became available. Though courts have ruled that "course packs", compiled without copyright clearance, violate copyright protection, there probably should have been a Congressional requirement that any copyright-registered publication be printed in some ink which xerographic machines were required to be able to detect and thus constrained so as to provide protection for the copyright holder(s).

We suggest that, in our current digital/electronic publishing environment with its facile digital scanning, copying, and transmission capabilities, the Library of Congress's Register of Copyrights provide—for each publisher/author who is submitting a document for its copyright registration—a *digital/electronic watermark* (including, of course, at the instant of transmission (back) to the registrant an electronic postmark of the date/hour/min. of the actual registration), the watermark to remain indelibly thereafter within the entire copyright-registered document. The return of *this* copy to the publisher/author would make the latter feel more secure in the realisation that *any* subsequent copy or tele-transmission (of any part) of his/her copyright-registered work would reveal its copyright status.

Table I: Why Television Broadcasting (Video/Cinema) DOES Indeed Cause Violent and/or Promiscuous Acts

Prepared and distributed at the Computers in Libraries 2000 Conference, yet presented verbally in 1999 at Colloquium: University of Southern California's Annenberg School of Communication.

A. Each individual, from infancy to senility, builds in his/her brain a personal neural library of experiences aa he/she individually develops, then trains, its neural librarian (his/her mind), including experiences with parents, preacher/priest, and teachers (eventually adding peers, however immature).
---*AMERICAN SCIENTIST* 67: 394, 1979.

B. Not until adolescence is the individual capable of fully developing his "personality", that set of personally neurally-developed 'algorithms' for conducting his/her proper behaviour as an adult in the national society in which he/she is about to enter.

C. Yet, today's children are devoting a considerable percentage (often over 25% to 30%) of their upbringing hours in front of TV broadcasts (and/or videos or cinema shows).

D. Indeed, we have to recognise that we have allowed TV broadcasting to become today's child's parent, preacher/priest, AND teacher.
---*BOOKLIST (American Library Assoc.)* 76: 204, 1979.

E. Fortunately, we understand indeed—and very nearly algorithmically so—how one's mind constructs a model for conducting behaviour: eventually, personality itself, then (as an adult) even scientific conjectures and models.
---ROLE AND EFFECTIVENESS OF THEORIES OF DECISION IN PRACTICE
(NATO Conference on Decision Theory (Luxembourg: 1972): London: Hodder-Stoughton, 1975.

F. Nobel Laureate Konrad Z. Lorenz:
"I thank you very much…for sending me your highly interesting paper[1]….I realise that our thoughts have run on very parallel paths indeed. I used to add to trains of thought dealing with models and analogy that everything (Lorenz's emphasis!) we can know is based on an analogy of real things, built up in our nervous system."
---Personal communication (30 AUG 1974).
[1] "Human Knowledge: The Role of Models, Metaphors, and Analogy,"
INT'L JOURNAL OF GENERAL SYSTEMS 1: 41-60 + 281, 1974(1971).

G. Children are almost always at the task of making (elementary) analogies. If their upbringing has not (or, has not yet) DISCIPLINED their minds so that they discern between proper and improper behaviour, then (statistically speaking) it is virtually inevitable that at least one of these will commit an atrocious (or, say, pernicious) act—like one which he/she has just retrieved from his/her neural library, one filled with views from TV (or video or cinema or those formed from musical lyrics).

H. *Conclusion:* TV broadcasting officials can simply NOT claim that their broadcasts have not caused many, many of the atrocious behaviours which we have 'witnessed': not only those quite unexpectedly by children but also those by adults conducting themselves (quite immature, adolescent-like) promiscuously: Both behaviour patterns we are now experiencing internationally as well, with televison becoming worldwide via satellite broadcasting!

Of course, under penalty of law, the illicit hacker who might attempt to erase or eradicate the digitally-watermarked "copyright seal" would be prosecutable, probably more easily so if it also be standard-operating procedure that any of his/her re-transmissions would each have the national electronic postal service's enhanced electronic postmark also applied thereto.

Content Markers

In effect, this procedure of having an omnipresent 'national electronic postmark' permits a concomitant set of content-markers, an attribute not at all unfamiliar to postal services. For example, a copyright-warning tag could be placed within the electronic postmark which accompanies any transmission which carries one or more of the indelible copyright-registration electronic-watermarks within the "electronic seal".

Furthermore, just as has been the case with the postal service, a citizen should be able to expect that content-markers be required for any transmission which is pornographic or obscene. Once the convergence of technologies [tele-computer + tele-phone (digital voice) + tele-graph (E-mail) + tele-vision (video-on-demand, cable, e.g.)] is complete on the Internet (Web), then obscene, violence-filled, promiscuous, pornographic, and/or linguistically objectionable material, particularly via the video format, will become even more clearly recognised as requiring content-markers, just as we would expect would accompany comparable materials despatched via the post.

There seems to remain some unwillingness to concede that broadcasts or displays of obscene, gratuitously violent, and/or pornographic materials can "CAUSE" individuals to commit such offensive and/or illegal actions subsequently. We call to the attention of the reader the recent report (Singhal & Rogers, 1999) of a rigourously-conducted social experiment which has shown that radio broadcasting (even without the added effects of the visual images accompanying TV/video broadcasts) provokes sexual misbehaviour. For a scientific understanding as to *why* we should always have known that TV/video/cinema *cause* so many of the violent, criminal, and/or promiscuous acts which confront us in news broadcasts virtually daily, we have prepared Table I (above). See also Mihram &Mihram 2000.

We do not expect that each individual would concur with each other individual as to whether the numbers assigned to the proposed P/L/V (Pornographic/Linguistic/Violent) triad, from (0/0/0) to (9/9/9), are correct, but requiring that they be supplied by a producer of a commercial product at the very time of its copyright registration and therefore incorporated in its 'text' should be anticipated.

We therefore are decidedly not in any way calling for governmental censorship in this proposal for such (P/L/V) content-markers. Indeed, we suggest that private resources (such as one's Church, or one's pastor, or an *'Electronic Family Circle Magazine'*, or an *'Electronic Consumer's Report'*) provide subscription service so that one, in his/her home, school, or library can, employing what will surely become the "Second-generation V-chip", forbid the display of objectionable materials according to very set of criteria which he/she has selected (including any electronic reviewers' opinions).

Conclusions

We have proposed that the historical perspective be employed in order to guide an order to the ongoing convergence of the technologies [tele-computer + tele-phone (digital voice) + tele-graph (E-mail) + tele-vision (video-on-demand, cable)], particularly as it affects the "domestic tranquility" which our republic expects that its Congress provide.

Primary among these is a requisite recognition that there be a governmentally-secured and -operated National Electronic Postal Service, quite in consonance with the requirement of *the Constitution of the United States of America* that Congress provide post-offices and post-roads for the person-to-person transmissions, even now that we have indeed entered into our Age of Tele-communications from our earlier Age of Written/Printed Communications (Mihram 1975).

An immediate corollary of this recognition is its concomitant, an 'Enhanced Electronic Postmark', one which, because of the near-invisibility of the tele-computer, implies that computer-to-computer communications should include an 'Electronic Return Address'. The enhanced electronic postmark might just as well make room for the dispatcher of a message to include any further identifiers, even of the biometric class, thereby enabling a more prompt authentication by a receiving computer before authorising access to its files.

Another matter of concern in our electronic/digitised world has been copyright protection. Though Congress and/or our courts may have extended copyright protection where it was never intended (viz., to recordings of musical and/or dramatic performances), we note also that, by extending to these copyright protection, the US Register of Copyright should be in a position to use, just as should be the case for the National Electronic Postal Services' enhanced electronic postmark, digital/electronic watermarking so as to provide copyright protection for holders of copyright-registrations.

We furthermore propose that the electronically-indelible copyright registration-markers be required to be carried in any subsequent transmission's enhanced electronic postmark.

By means of properly designed and controlled electronic log-books at each computer, we reveal how the privacy of one's personal files located elsewhere can be protected. Furthermore, every governmental computer accessing personal data shall need be required to advise periodically, of each attempted or successful access to any piece of the personal data.

Finally, we present literature which scientifically reveals the cause-and-effect connexion between broadcasting and subsequent aberrant and/or illegal conduct. We note procedures by which, without any need for governmental censorship, access to such materials can be restricted on the Internet/Web, once this is properly secured within the National Electronic Postal Service.

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Re-examining 3D Web Technologies for Education

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Abstract: The last year has seen a resurgence of technologies and applications designed for the creation and delivery of 3D objects and environments over the web. Complaints of the various shortcomings and inadequacies associated with VRML caused support and excitement for 3D on the web to wane. Many questioned the viability and whether there was even a need for 3D on the web. Yet, for spatial ability instruction as well as a wealth of other purposes, web virtual reality is vitally important and undoubtedly appropriate. The focus of this contribution is to highlight the importance of spatial ability in education and to describe the current state of 3D technologies that are applicable to the improvement of spatial ability.

Introduction

Over last few years there has been a resurgence of literature identifying spatial ability as an important factor of intelligence. With the wealth of computer-based tools that are more readily accessible in education, this resurgence should be no surprise. Studies focusing on spatial ability began as early as 1921 and have continued throughout the years in various forms (Thurstone, 1921). However, even after 75 plus years of research concerning it, spatial ability is still an ill-defined construct. Researchers have defined spatial ability as composed of a myriad of different sub-abilities and they do not agree on all aspects of identifying and classifying it (Pellegrio, et. al., 1984; Lohman, 1979; McGee, 1979). Nevertheless, there is still agreement that spatial aptitude is a vital human intellectual faculty. From visualizing abstract data structures to the picturing physically discrete components of tangible mechanical parts, spatial cognition is a highly coveted skill, regardless of the disagreement concerning the constituents that compose it and the methods used to measure it.

Experts from many seemingly unrelated fields share the belief that spatial ability is a significant component of a variety of disciplines, one that is often paramount for success in those disciplines. Studies in astronomy (Bishop, 1978), chemistry (Coleman, S. & Gotch, A., 1998; Khoo & Koh, 1998; Baker & Talley, 1972), biology (Lord & Nicely, 1997), engineering (see Miller, 1996), geology (Yakemanskaya, 1971), music (Hassler, et. al., 1985), mathematics (Kiser, 1990; Sherman, 1967; Smith, 1964), and physics (Anderson, 1976; Pallrand & Seeber, 1984) reveal the importance of spatial ability in these disciplines. That a wide range of research concerning spatial ability exists is no question. Nevertheless, it can be confidently stated that without spatial abilities students are often hindered in learning and ultimately within their chosen field (Bertoline, et. al., 1992).

With the acknowledgement that spatial ability is important, it is meaningful to identify the primary methods that have been used to increase the spatial abilities of students. Many researchers have suggested that the phenomena cannot be taught, rather implying that it is an innate ability (McFie, 1973; Witkin, 1969; Smith, 1964). Yet, even at the time of these studies, contrary findings were being presented (Debono, 1976; Brinkmann, 1966). Historically, researchers have used numerous methods in an attempt to teach and further spatial abilities, each with varying levels of success. Traditional paper and pencil (Dejong, 1977; Newlin, 1979), real models (Wily, 1989; Wiley, 1990; Miller, 1992a), 2D CAD (Mack, 1995; Mack, 1994), 3D CAD (Devon et. al., 1994; Braukmann & Pedras, 1993; Miller, 1992b; Leach, 1992; Vanderwall, 1981), 3D animation (McCuistion, 1990; Weibe, 1993) and computer games (Dorval & Pepin, 1986) have all been used in an attempt to improve student spatial abilities. Although not an exhaustive list of approaches or studies, an increase in the capabilities of the desktop computer has dramatically multiplied the various strategies that can be employed and time it takes to establish such as system.

At present, however, more and more studies are aimed at discovering appropriate technologies and apposite techniques that can be used with relative confidence in spatial ability instruction. One such technology is virtual reality (VR). When combined with the global accessibility and dynamism of the web, VR technology provides a readily available and adequate means for delivering spatial ability instruction.

Virtual Reality: Myths and Realities

The desktop application of VR is far from the complete and perfect representation of the real world often portrayed by the mass media. Several technical limitations prevent the real-time display of completely photo-realistic environments with total submersion on the desktop because all media is subject to three sets of constraints: cognitive, structural, and technical. With VR, the most significant limitation is in the technical venue. Tremendous processing requirements, high data rates, and expensive display technologies limit the amount of realism that can be provided. Although considerable research in hardware and software development is taking place, VR technology has not advanced to a stage that can provide the "real world" on the desktop. Yet contrary to most assumptions about VR, this is not its purpose. VR is about experience and interaction, not the complete and unwavering simulation of reality.

To qualify the level of reality of VR systems, several researchers are developing scales by which these systems can be measured and compared. Thurman and Mattoon (1994) presented a model that classifies VR implementations based on three dimensions: verity, integration, and interface. The verity dimension attempts to describe the level at which the environment or the objects represent true reality (realism). The integration dimension describes how the user is integrated and represented in the environment (emersion), and the interface dimension describes how the user interacts with the environment (interaction).

Currently, an environment that provides the maximum in all three dimensions, the Star Trek "holodeck" type experience, does not exist. However, several technologies show promise in reaching this within the next 20 years. Advances in optical output, forced feedback and even devices designed to stimulate the olfactory senses are emerging. Research into direct nerve input is also being examined (Warwick, 2000). VR technology is in its infancy and it has significant development potential.

Modern VR systems can be divided into two major categories: complete systems and software-only solutions. Complete systems usually include closed environments with multiple dedicated workstations. This category also includes an entire range of augmented VR systems that combine certain specialized physical devices combined with digital technologies. Because such complete systems require expensive input and output devices such as data gloves, headsets, and body suits, not to mention high-powered workstations, complete VR systems are inaccessible in most educational institutions and financially infeasible for education en masse. Additionally, such systems are usually reserved for specialized research and large budgets. Due to these limitations for mass education – they are not highly distributable – they will not be examined further in this paper.

However, of relevance to educators is the myriad of software-only VR solutions that are much lower in cost and can yield respectable environments for spatial instruction, as well as communication to the general public. Because software-only VR solutions are broad, attainable and viable for most institutions, the remainder of this contribution describes the different types of software-only VR solutions that are currently available.

Software-based VR

Software-only solutions provide a low-cost means of creating and delivering VR in educational settings. The hierarchy of solutions includes two major subcategories: 3D and 2D solutions (Fig. 1). The 3D solutions integrate true 3D objects and environments, while 2D solutions utilize static images that simulate a 3D environment. In each of these categories, proprietary and non-proprietary technologies exist, each of which carries with it certain disadvantages. Choosing a proprietary technology limits development to those features and functionalities supported. Additionally, if the technology is at some point discontinued, further research may be hindered. Similarly, non-proprietary technologies, many of which have limited documentation and some of which has hundreds of pages of documentation may stagnate development due to the learning curve associated with them. Choice of technologies must be made very carefully to ensure the viability of research today and implications for continued work in the future.

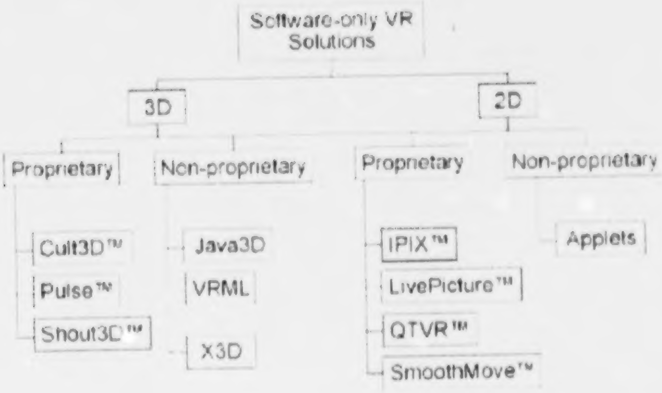

Figure 1. The hierarchy of software-only VR solutions includes both 3D and 2D solutions.

Both the 3D and 2D solutions have advantages and disadvantages. The overall decision of which to choose is based upon the level of realism needed versus the level of interaction. The main advantage of the 3D technologies is that they excel at interaction. Because the 3D solutions are true objects and environments represented in the computer, all of the interaction allowable within the real world (as well as some that is not) is permitted within them. However, for this capability, realism is sacrificed. When realism is key, as opposed to interaction, 2D technologies should be employed. Several major advantages and disadvantages of the 3D and 2D technologies exist (Fig. 2).

	3D Solutions	2D Solutions
Advantages	• Object-based/true 3D • Excels at interaction • Manipulate viewer and object • Establish predefined paths	• Raster/image-based • Excels at realism • Manipulate object or viewer • Can limit degrees of freedom
Disadvantages	• Low realism • File size / playback • Programming or 3D software experience • Documentation or lack of it • Requires browser components	• Interactivity is limited • Cannot interact with objects • Must predefine included views • Requires additional hardware and software for development • Requires browser components

Figure 2. The advantages and disadvantages of the 3D and 2D technologies.

3D VR Technologies for the Web

Both proprietary 3D technologies, such as Pulse™ (Duberman, 2000b), Cult3D™ (Fielden, 1999; Duberman, 2000), or Shout3D™ (Duberman, 2000c) and non-proprietary technologies, such as VRML (VRML Consortium, 1997), Java3D (Sowizral, 1997) and the next generation of VRML, X3D (Web3D Consortium, 1999), provide a means for integrating 3D worlds or objects on the web. In the case of the proprietary technologies, objects and environments are constructed using solid and surface geometric modelling techniques, from which digital files are then converted to a format usable by browser plug-ins. VRML and Java3D objects can be programmed or exported from off-the-shelf 3D software that support them. X3D, which stands for Extensible 3D, is a next-generation, extensible, 3D graphics specification that extends the capabilities of VRML 97 by wrapping scene descriptions within XML definitions (Web3D Consortium, 1999).

Although much development is taking place to extend the viability of true 3D on the web, the proprietary technologies have significant technical limitations in that the educator must have the ability to build and manipulate 3D geometry within various software packages. Some of the proprietary technologies are simply exported or converted from typical modeling and rendering environments such as LightWave or 3D Studio Max. For realism in these implementations, authors must have experience in building bitmap images (bump and texture maps) that are then applied to 3D surfaces to provide surface characteristics. Lighting, too, is a critical aspect that must be defined

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within the environment. The proprietary technologies often require the purchase of specialized software and require time to learn and use them, increasing the development cycle. Most proprietary and non-proprietary solutions also require additional browser components for viewing.

Of the non-proprietary 3D solutions, the most widely used are Java3D and VRML. VRML, which is the most cost effective, is the de facto standard on the web and is the most widely used of the two (Dörner, et. al., 1998). But as with the proprietary technologies, VRML provides a lack of realism (low verity) and requires significant bandwidth considerations for delivery. Additionally, the interface dimension of VRML browsers is often difficult to use and control for educational purposes. Students often become lost in 3D space, very similar to using 3D CAD environments for visualization. Thus, the tool has a tendency to get in the way of developing spatial ability. Other problems with VRML environments include (a) the lack of comprehensive collision detection within the environment, and (b) the inability to create complex and dynamic environments.

As an alternative to VRML, Java3D provides a purely object-oriented language-based approach to 3D objects and environments. Java3D utilizes a high-level Application Programming Interface (API) for scene control and creation. As such, it provides many of the same features as VRML while providing better integration in the browser, more complex object interactions and collision detection between objects. However, because it is a newer technology, environments for the creation of Java3D objects and scenes are somewhat limited. Additionally, depending on the method of coding, some Java implementations can be problematic across browsers or platforms. Certain features implemented within Java3D are browser-specific (Smith, et. al., 1999).

Using the rating system designed by Thurman and Mattoon (1994), the 3D solutions are far from reaching the highest rating for verity (realism) or integration (emersion). True 3D solutions are most aptly suited where interface (interaction) is key. Yet, three significant disadvantages exist with these technologies as well: (a) they often require far more processing power to utilize, (b) many download very slowly due to larger file sizes, and (c) the verity (realism) of these solutions is generally quite low meaning that polygonal edges are often quite visible. True 3D technologies excel within the interaction dimension, providing the ability to adjust yaw, pitch and roll of both objects and viewer. Thus, they are advantageous when interaction is more important than realism.

2D VR Technologies

Although the 3D technologies provide true three-dimensional environments that excel at interaction, 2D technologies should not be discredited. Where 3D technologies fail to provide photo-realism, 2D technologies excel. Unlike the 3D solutions, the 2D solutions are not based upon the real-time delivery of three-dimensional data, although they can be generated from 3D environments. Rather, they are composed of snapshots of predefined views that give the illusion of navigation within a three-dimensional environment or manipulation of a three-dimensional object. Because they are based upon predefined views, educators who use them can control the path of motion through an environment, or the translation and rotation of an object. Educators have complete control over the pedagogical degrees of freedom within the illusionary three-dimensional environment. A significant detriment with 3D technologies is that students can quickly become disoriented because of the infinite freedom within the three-dimensional environment, that is, the ability to manipulate objects and viewer independently. Frequently students can become lost in 3D space. By affixing either object or environment in the VR element, learners can more readily interact and understand the environment. Limitless navigation during learning can often defeat the spatial learning objectives (Mohler, 1997).

Nonetheless, just as the ability to limit navigation is beneficial for spatial instruction, it can also be a detriment. Within the 2D technologies, any navigable path or manipulation of an object must be captured and included within the VR element. This can be performed via photographic techniques or they may be rendered from a 3D scene or environment. The more paths or manipulations that need to be available increase the number of raster images within the VR element and consequently the file size. The time required to create complex navigation within 2D VR elements is greater than simple rotations or movements. Where 2D technologies excel is within the realism portrayed.

Several of the 2D technologies are based upon proprietary digital video movie formats or specialized file formats. All of the proprietary 2D solutions require a plug-in for viewing in a browser and accomplish the illusion of 3D using raster graphics. QuickTime is by far the most widely used of the available proprietary formats (Rohan, 1998). The predominant reason for this is that QuickTime was the first format to include the ability. Additionally, as the demographics site MediaMatrix (1998) indicates, QuickTime extensions are one of the top 50 software components owned and installed on business computers. Thus it has a widely installed user base. QuickTime based VR solutions allows the developer to create object movies, where the user can manipulate an object, or panoramas, where the user can view a scene. Other solutions include IPIX (Schindler, 1999), LivePicture and SmoothMove

The primary non-proprietary 2D solution for VR is the use of Java Applets, such as Cylpan by Nemang. These applets utilize static panoramic images, usually in JPEG format. Although not providing all of the features available in some of the proprietary formats, Java applets such as these provide the basic functionality of being able to pan or zoom objects or environments.

The 2D VR technologies provide three significant advantages over 3D technologies: (a) they are usually less time-intensive to create, (b) they are easier to deliver over the web, and (c) they provide a means to deliver photo-realistic content. However their negative aspects include the fact that (a) interaction must be predefined and can be limiting, (b) they are composed of raster images -- users cannot interact with objects, and (c) they require additional hardware or software for the creation of the raster images.

Conclusions

Both 3D and 2D technologies provide a means to deliver VR environments on the web. Often individuals find themselves touting a particular technology simply because it is en vogue, implying that all other technologies that may exist are subservient and irrelevant. However, decisions should rather be made on the needs at hand. Both 3D and 2D technologies have a time and a place where they are applicable. Where interaction is key to research, where complete navigation within an environment needs to exist without having to conscientiously program it in, and where realism is less import, 3D technologies should be used. Where realism is key and navigation needs to be limited, 2D technologies should be chosen. In either case, careful consideration needs to be given to the choice of proprietary versus non-proprietary technologies. Due to future directions for research, non-proprietary technologies are generally preferable to closed, proprietary formats.

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Adjusting to Specialties of Search Engines Using MetaWeaver

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Abstract:

In this paper, we propose MetaWeaver which can selectively utilize effective ones from registered search engines depending on queries. Traditional meta-search engines use all the registered search engines without considering which search engines are appropriate, and often return many irrelevant Web pages in the hit list. In contrast with that, MetaWeaver is able to evaluate the specialties of each search engine by analyzing the hit list for sample queries, and to utilize them for selecting adequate search engines for current queries. Also we found out our approach is promising by making preliminary experiments.

1 Introduction

There are currently a lot of search engines to retrieve relevant Web pages to a query from the World Wide Web (WWW). In view of the characteristics of the stored Web pages, the search engines are categorized into two groups. One group is general all-round search engines like AltaVista[1]. The other group is special search engines like DogInfo[2], which is a dog-specific search engine. Because a general search engine have a huge database, we use it for searching any query. However there is a significant issue that the coverage of a general search engine is significantly insufficient. The Web size and the size of each search engine's database were surveyed in (Bharat & Broder 1998). The largest search engines covered 50% of all of the Web pages and maximum overlap of search engines is 30%. Thus a user can not search well using a single general search engine.

A meta-search engine solves the issue by ask other search engines about the queries. It does not collect pages in the Web by itself. Instead it registers other search engines in advance, and requests them to retrieve for the queries and gather their results. Then the meta-search engine provides a hit list of Web pages by integrating the hit lists from other search engines and removing overlapping pages. However a meta-search engine also has a significant problem: it can not selectively utilize registered search engines depending on their specialties. Hence it always requests all the registered search engines and the integrated hit list include many irrelevant Web pages. Though some meta-search engine ask a user to select adequate registered search engines, he/she hardly recognize specialties of each search engine on the queries and select effective ones from them.

We propose MetaWeaver which can grasps specialties of each search engine and request search engines whose specialty is content of the queries. When it estimates search engines, it uses thesaurus for improvement of estimate. Therefore, it is expected that Web pages from it satisfies user's queries more precisely than traditional meta-search engines.

MetaCrawler (Selberg & Etzioni 1997) requests all handled search engines in parallel and removes duplication. Inquirus (Lawrence & Giles 1998) also submits all search engines. However, it downloads the Web pages in hit lists from the search engines and then, it calculates relevance to the query using downloaded pages.

On the other hand, ProFusion (Fan & Gauch 1999) selects appropriate search engines to request them to search. It manually builds categories from the words of the newsgroups names and it can only select when the words include words of user's query.

SavvySearch (Howe & Dreilinger 1997) can also select proper search engines. It uses words of users' queries and their effectiveness values. Visited links by users evaluate the value. SavvySearch, however, does not use any thesaurus. Therefore, it will not evaluate search engines on initial steps of searches.

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[1] http://www.altavista.com/

[2] http://www.doginfo.com/

2 MetaWeaver

Meta-search engines need to choose proper search engines for queries a user requested. MetaWeaver can detect effective search engines by the word used as in queries. The architecture is shown in Figure 1.

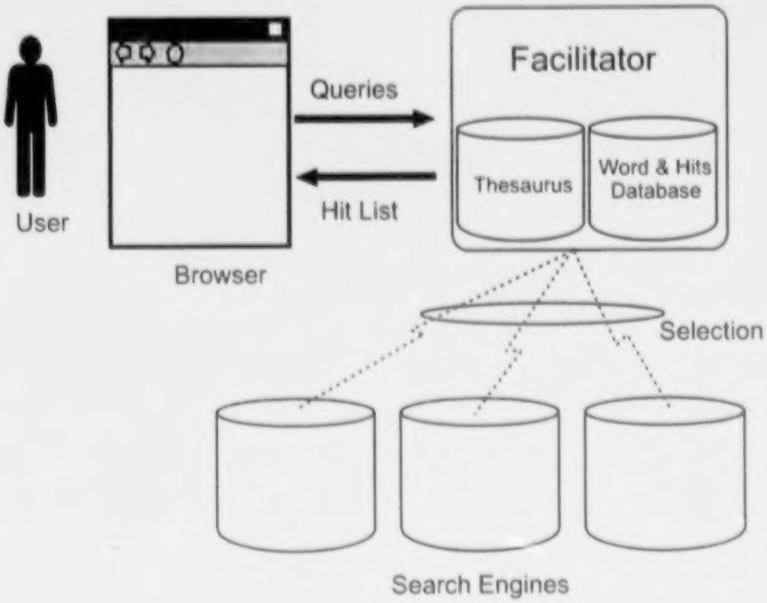

Figure 1: The architecture of MetaWeaver

2.1 Search Overview

A user writes queries to the meta-search engine to submit them on a his/her browser. Users can make queries as AND, OR search or these combinations.

The facilitator selects some search engines from registered search engines as appropriate search engines of the user's query when a user make a submission. We define a suitability to choose appropriate search engines and the detail of suitability is described in section 3.

The facilitator send user's query to selected engines in parallel. It waits while all engines return lists of top 10 hits. When it gets the hit lists, it integrates into a hit list to display the user's browser. The way of integration for making the meta-search hit list is described in section 4.

The suitability is updated after the user gets the hit list. The suitability of each word in the query is based on the number of hits of the word. Therefore, the facilitator gets the number of hits of each word from each of all registered search engines and writes the numbers into the word and hits database with search engine names. Thus, MetaWeaver behaves adaptively toward the changes of search engines' databases.

2.2 System Requirements

MetaWeaver utilizes AltaVista[3], Yahoo[4] and Infoseek[5] as general search engines and also utilizes DogInfo[6] (a dog specific search engine), BioCrawler[7] (a biological search engine) and LawCrawler[8] (a law search engine) as specialty search engines.

For thesaurus, MetaWeaver utilizes the EDR Electronic Dictionary[9]that contains the relation between four hundred thousand concepts.

3 Calculation of The Suitability

MetaWeaver needs to measure the suitabilities for choosing appropriate search engines. The appropriate search engines is regarded as search engines which returned large number of hits according to queries before. Larger hits tend to be less precision, which is the relevant pages per hit pages, but more relevant pages actually include.

In this section, we present a method to measure the suitability of a single-word and a combined-word query.

3.1 A Single-word query

When a query consists of a single word, the suitability $p_{s,w}$ of a search engine s for word w is the number of hits divided by the size of search engine s:

$$p_{s,w} = \frac{u_{s,w}}{U_s} \tag{1}$$

where $u_{s,w}$ is the number of hits from the word and hits database and U_s is the search engine's size.

However, it is not usual that the search engine opens its size. Therefore, MetaWeaver uses the history of hits from the word and hits database for the last f_s words of each search engine. f_s is currently 100. We express U_s instead of exact search engine size as follows:

$$U_s = \alpha_u \sum_{i=1}^{f_s} u_{s,w_{n-i}} \tag{2}$$

where u_{w_n} is the number of hits of the nth word from the last and α_u is the correction factor for approximating summation of u_{s,w_n} to U_s.

Here, the thesaurus improves $p_{s,w}$. If MetaWeaver does not use any thesaurus on initial steps of searches, it does not initially decide right estimation of search engines for choosing appropriate ones because it estimates the suitability at zero not to have the number of hits about the words in a query in the word and hits database.

By using thesaurus, MetaWeaver to be able to compute $p_{s,w}$ not only when w do not have any records in the word and hits database but also when w have records. The suitability after improvement by thesaurus is described:

$$p_{s,w}^{imp} = p_{s,w} + \frac{\sum_{m \in W_t} \delta_{w,m} p_{s,w}}{|W_t|} \tag{3}$$

where $p_{s,w}^{imp}$ is the improved suitability, $p_{s,w}$ is the suitability of each word in a synonym set W_t and $\delta_{w,m}$ is the weight of relation between w and a synonym m. $\delta_{w,m}$ between each word and each of its synonyms is set 1 currently.

3.2 A Combined-Word Query

We consider the case in which a query contains several words combined with boolean AND / OR. The result of AND searches are generally smaller than that of each word in the queries, and that of OR searches are oppositely larger than that of each word. Hence we express the suitability of an AND / OR search as follows.

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[3] http://www.altavista.com/

[4] http://www.yahoo.com/

[5] http://infoseek.go.com/

[6] http://www.doginfo.com/

[7] http://www.biocrawler.com/

[8] http://lawcrawler.findlaw.com/

[9] http://www.iijnet.or.jp/edr/index.html

AND search The suitability is calculated as the geometric mean of every $p_{s,w}^{imp}$ for every w in the query q:

$$p_{s,q} = \left(\prod_{w \in q} p_{s,w}^{imp} \right)^{\frac{1}{|q|}} \tag{4}$$

OR search The suitability is calculated as the average value of every $p_{s,w}^{imp}$ for every w in the query q:

$$p_{s,q} = \frac{\sum_{w \in q} p_{s,w}^{imp}}{|q|} \tag{5}$$

4 Ranking Web Pages from the Search Engines

For obtaining a single hit list, MetaWeaver ranks Web pages in hit lists to order them. MetaWeaver employs the suitability of each search engine and hit ranking of each Web pages in the hit list from each engine for the single list.

A score $\sigma(p)$ of a Web page p expresses as follows:

$$\sigma(p) = \sum_{s \in S^{ap}} \frac{p_{s,q}}{k(p)} \tag{6}$$

where S^{ap} is appropriate (query-requested) search engines, $k(p)$ is the ranking of the page p in a hit list from a search engine.

Here, the top page of the list obtains 1 and the 10th page obtains 10. If a search engine s does not have p in the list, $\frac{p_{s,q}}{k(p)}$ is zero.

5 Experiments

We made experiments to evaluate the effectiveness of using suitability in MetaWeaver. To simplify the experiments, we do not employ thesaurus for the improvement of the suitability, and the word and hits database has already stored randomly 2000 words in the thesaurus and their hits. Also the queries for a evaluation in the experiment are 'dna', 'soccer' as single-word queries, 'golden AND retriever' and 'punitive AND law' as combined-word queries. We choose 100 for the correction factor f_s that is the history of hits from the word and hits database and 10 for α_w.

Experimental results are shown in Table 1. In the table, "IS" means Infoseek, "AV" means AltaVista, "YH" means Yahoo, "BC" means BioCrawler, "LC" means LawCrawler and "DI"means DogInfo. If MetaWeaver selects correctly appropriate search engines, it will get right lists of ranking of search engines for each query. The lists are sorted largest first by the suitabilities of the search engines.

The results indicate our aiming tendency toward estimating specialty search engines' suitabilities at the top. The query 'soccer' does not have precise specialty search engines. Thus, no specialty search engine is the top and the general search engines occupy the top three. The suitability of the top one or two is ten times larger than that of below.

Table 1: The search engine ranking of the queries

	dna		soccer		golden retriever		punitive law	
Ranking	SE	p_w	SE	p_w	SE	p_w	SE	p_w
1	BC	0.02336	AV	0.01317	DI	0.11111	LC	0.00203
2	DI	0.01296	IS	0.00311	YH	0.00026	AV	0.00015
3	LC	0.00715	YH	0.00285	AV	0.00018	YH	0.00000
4	AV	0.00346	LC	0.00148	IS	0.00003	IS	0.00000
5	IS	0.00187	DI	0.00092	LC	0.00000	DI	0.00000
6	YH	0.00047	BC	0.00000	BC	0.00000	BC	0.00000

6 Conclusion

Ordinary meta-search engines present too abundant Web pages over since they had submitted all of the registered search engines. Also specialty-sensitive meta-search engines like SavvySearch does not consider effect of thesaurus. MetaWeaver solves both disadvantages. MetaWeaver selectively utilizes fewer search engines with a suitability.

In the experimental results, we confirm that the definition of the suitability is valid. We will use this system for a long time to investigate whether it adapt real person's queries or not.

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A Web-based Model for Online Collaboration between Distance Learning and Campus Students

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Abstract: The increased attention on distance education has influenced many institutions to expand their physical boundaries and develop distance learning courses. This paper presents a hybrid course framework that seamlessly integrates a traditional course plan designed for on campus students with an online course plan designed for distance learning students. Based on innovative teaching and learning principles, the course encourages active participation in the construction of knowledge through student interaction and teamwork. Preliminary findings revealed that this framework was effective in promoting online collaborative sharing of information and engaging students in active construction of knowledge.

Introduction

The increased attention on distance education has influenced many institutions to expand their physical boundaries and develop distance learning courses. About two years ago, Teachers College at Columbia University started a pilot program by offering three online courses. This program is one of the many initiatives organized by the Distance Learning Project (DLP), an interdisciplinary center for the advancement of online education. Currently, there are more than ten online courses and several on-demand workshops offered through the Distance Learning Project. Those courses are specifically designed for people who cannot attend face-to-face classes on a regular basis due to constraints of time, space or distance. Moreover, online courses attempt to respond to the needs of the working student population who requires more flexible educational options.

Many efforts to use the web as an instructional tool at the university level emulate existing traditional approaches to learning. In a traditional class arrangement, the instructor, as the expert, delivers information to the students who maintain a rather passive role. A predominantly asynchronous online environment seems to require an alternative communication structure in which student-to-student interaction becomes an essential element in support of learning. In this paper we present an example of a new instructional framework in which online and campus students are virtually brought together to explore issues related to Television and the Development of the Youth. Course designs for both online instruction and classroom instruction are seamlessly integrated into a hybrid course framework. Based on innovative teaching and learning principles, the course encourages active participation in the construction of knowledge through student interaction and teamwork.

Description of the Instructional Framework

Television and the Development of the Youth is a graduate course offered by the Department of Communication, Computing and Technology in Education at Teachers College. The course is comprised of four main areas related to television and the development of children: 1) television as an industry, 2) effects of television on behavior, attitudes and beliefs, 3) public policies around television, and 4) media literacy at home and at school. The objective of the course is to help students become critical television viewers and understand the impact of television on the development of young children. In addition, students learn to identify and develop attractive educational television programs.

During the fall Semester of 1999, we offered this course in two formats, a distance learning format and a face-to-face format. Our plan was to merge the two classes and have them interact at a common virtual space. The course comprised of twenty-two distance learning and eleven face-to-face students. Both groups of students used the same course site, syllabus, readings, assignments, and online discussion area. Assignments from all students were submitted asynchronously in the online discussion space and were made available to comment and respond.

The only difference between the two formats of the course was the face-to-face meetings held on campus. There are two reasons for offering the course face-to-face in the first place; first, many campus students do not yet feel very comfortable with Internet tools and feel intimated in attending a purely online class. In fact, during the first meeting we held with face-to-face students, some of them expressed concern that communication and interaction would mostly take place in an online environment. Second, because some students pursuit their degrees full-time and spend a lot of their time on campus, they prefer to participate in regular weekly meetings with their instructor and peers.

Face-to-face sessions were designed in such a way that they did not provide any additional advantage to campus students. Moreover, online students were welcome to physically participate if they chose to. In several occasions online students came to class to meet the instructor and their peers. However, once they realized that all materials were available online they never came again. After each class session, a student volunteer posted a brief summary on the discussion space so online students could comment on what it was discussed during that session.

The course design is based on the principle that communication should include a broader audience, should be based on issues and interests, and should not be restrained by constraints of time or distance. In order to successfully integrate face-to-face and distance learning students it is necessary to structure the course in such a way that neither group has an added advantage. The Internet provides a medium that can achieve such integration. By bringing the two groups of students together in an online environment, we essentially expanded the traditional classroom boundaries and provided all students the opportunity to access the course material and interact with each other on around the clock basis.

Instructional Design Online

The development of the online framework of the course is based on a distance learning model to teach Instructional Design of Educational Technology, previously developed at Teachers College by Bell and Kaplan (1999). This model calls for design techniques that support increased group interaction, which is critically important for the success of a course at a distance. Several new attributes, however, were developed to address the specific aspects of the course related to the nature of its content. For example, we developed two new archives, the Television Show Archive and the Lesson Plan Archive, where students could store information related to television viewing.

Our course site consists of five sections that can be selected from a navigation banner on top of the site: a) Getting Started, b) Participant Info, c) Course Central, 4) What's New, and 5) Help Center. Figure 1 shows the welcome screen from the course site. Under each section there are sub-sections that can be viewed and selected from the left site of the screen when a major section has been chosen.

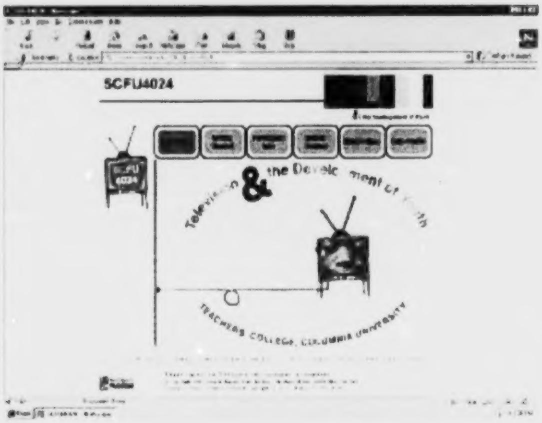

Figure 1: Welcome screen from the course site

Getting Started: The Getting Started section provides orientation information, an outline of the course and an explanation of registration procedures.

Participant Info: The Participant Info section includes four sub-sections: a) online student database, b) instructor's section, c) additional contacts, and d) participant status. Students can use this section to introduce themselves, contact other classmates or the DLP personnel, meet the instructor, and check on the progress and timeliness of their assignments throughout the semester.

Course Central: Course Central is the main area of the course and includes the syllabus, assignments, demonstrations, lecture slides, and the meeting room.
The *Syllabus* consists of twelve modules. Each module is accompanied by online readings and lecture slides. Most of the readings are hypertext links embedded within each module. Printed documents were sent to the distance learning students via surface mail.

Assignments are designed to help students reflect on their television viewing experiences and integrate readings for the development of a final project. Short assignments are posted online every week so that other students in the class may read and respond. Some assignments require students to analyze data from the Television Show Archive database, which is filled out at the beginning of the course. (The Television Show Archive is explained in detail later in the paper). As a final project, students are required to create an original educational show or adapt an existing commercial show and convert it into an educational one. Assignments help students make connections between readings and viewing experiences. They also stimulate reflective thinking in order to promote new understandings in this domain area.

A challenging component of the course is the *Demonstrations* section. Initially, we thought of incorporating streamed video to demonstrate few examples online. This idea was dropped quickly for two reasons: First, the course usually attracts many non-departmental students who are not proficient with Internet tools. Therefore, additional plug-ins and technical requirements might discourage student participation. Second, streamed video limits student flexibility to analyze other appropriate shows if they choose to. Consequently, we encouraged students to watch television shows of their choosing at different times of the day and discuss them in relation to the weekly readings. Providing students with the opportunity to identify and watch a show of their interest offers them a sense of freedom and choice. Consequently, we shifted control away from the instructors and promoted a more learner-centered approach.

The *Demonstrations* section includes television schedules from around the world, as well as official web-sites from major television networks (e.g. CBS, NBC, ABC, CNN). In addition, web-sites from major public, non-profit organizations in the area of educational television are also provided (e.g. PBS, CTW). Finally, we provide

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information and web-sites for selected miscellaneous educational programs (Sesame Street, Reading Rainbow, Time for Teletubbies, Barney and Friends, Mister Rogers' Neighborhood etc).

The *Meeting Room* is the primary communication area. It supports synchronous (chat) and asynchronous (bulletin board) interaction. The chat room permits live scheduled group discussions, including multiple one-to-one private chats. Class-wide chats are transcribed and published on the course site. The bulletin board provides a space for students to post individual and group assignments and receive feedback from the instructors and their peers.

The bulletin board consists of multiple discussion forums. Specifically, there is one forum for each topic addressed in the syllabus and one forum for each group stage. Forums are clearly labeled to help students understand where to post their contributions. Two additional forums permit students to ask technical questions and post announcements. Organizing the online discussion space is important for allowing students to follow discussion threads. Moreover, separate online forums help keep discussions more focused.

Course Archives

The Television Show Archive is a database-driven resource tool. At the beginning of the semester all students record and view a show of their choice and fill out a corresponding form in the Television Show Archive. Students collect information about the structure, audience, characters and advertisements of television shows. The Television Show Archive is intended to be a set of observation resources that can be used not only by students, but also by the larger academic community to study television patterns.

During the course of the semester, students are asked to make references to the Television Show Archive, interpret and contrast the data with course readings, and construct their own interpretations and understandings. For example, some assignments require students to draw conclusions regarding violent acts, ethnic diversity, and gender representation by analyzing and synthesizing data from television shows.

The Lesson Plan Archive provides students with an appropriate format for developing media literacy lesson plans. Users can sort lesson plans based on topic and age group. In addition to registered students in this course, instructors and students in other courses can also access the archive if they want to incorporate media literacy in their classrooms. Therefore, the two archives serve as primary sources of distributed information.

Interaction and Collaboration in the Online Environment

One of the basic concepts underlying the design of the course is that learning is a social experience. Therefore, intellectual development is significantly influenced by the social interaction between teachers and students, as well as between students and students (Honebein, 1996). Moreover, the construction of knowledge depends on the active and collaborative sharing of information and experiences. Consequently, participation of students in online discussion was highly encouraged, valued, and expected.

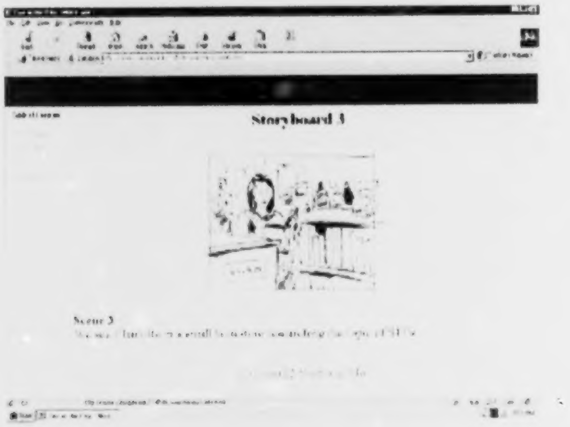
The weekly individual assignments are designed to stimulate interaction in order to help students place structure and coherency in their understanding. Moreover, interaction with peers helps students forge new connections between formerly disconnected knowledge and identify similar experiences. (Edelson, Pea & Gomez, 1996). An example of online interaction around gender portrayals on television follows:

> *T:* The first image that came to mind after completing our readings this week was the Super-bowl. Every year key advertisers save their best commercials for this spectacular sports event that millions of people watch nationwide. Because I am not an avid viewer of football, I was unaware how sexist these commercials can get. *October 16, 1999 11:07 AM*
>
> *A:* T, you made some very interesting points (that I agree with) when it comes to assumptions about sexuality and portrayal of men and women on TV. I was thinking about what you said and I realized that not only are TV shows catered towards popular markets, particularly young white markets, they are also catered to heterosexual markets. *October 19, 1999 12:23 AM*

Group work can stimulate the development of a cooperative learning environment where multiple ideas are generated, therefore, enriching the learning process. Group work in this class culminated in a final project that required the creation of an original educational show or the adaptation of an existing commercial show into an educational one. Each group consisted of three to five students. Early in the semester, students brainstormed ideas in the meeting room and formed groups according to their interests. The final project progressed incrementally through the semester. Students interacted regularly with group members and reported their collective views and outcomes. An example of group brainstorming follows:

> *J*: Let's chat at 4pm on Thursday, just for a little bit. Let's all think of what kind of issues might be interesting to talk about in our show. I will also record the *Sex in the City* show so we can talk about it. *September 28, 1999 09:12 PM*
>
> *R*: I was just reading the article "Children, Adolescents, and the Media: Five Crucial Issues" and a section from Issue No.4 ("What can be done to improve the quality of television?") reminded me of our project. A possible answer is the adoption of a uniform television industry code that insists on responsible portrayals of sexuality. There is also a short section on sex/sexuality and television that you might want to check if you haven't already. *September 28, 1999 10:33 PM*
>
> *J*: I also thought that point No. 4 of Strassburger's five points was very relevant to our project. Have either of you seen those ads on TV for birth control pills? The greatest selling point is that it clears up your skin! *September 29, 1999 01:29 PM*

In order to complete their weekly group assignment, students used the chat room, e-mail, and discussion forums. In addition, each group received weekly feedback on the progress of their project from their peers and instructors. At the end of the term, most groups developed a web site to present their project. Figure 2 shows a screen from the final project *Someone's in Terrible Denial*, an adaptation of the television show *Sex in the City*. Students in this group chose this show to discuss issues on sexually transmitted diseases.



Storyboard 3

Scene 3

Figure 2: Screen Shot from the Final Project *Someone's in Terrible Denial*

Since campus students held regular face-to-face meetings and knew each other better, we expected that many of them would form teams with each other. We were particularly encouraged that all final project groups included members from both face-to-face and distance learning classes. This fact provides evidence that member participation in a group was based on interest for specific topics and stance on social issues rather than physical proximity and ability for face-to-face communication.

Overall, it was obvious that students actively participated in the online cooperative project. All teams demonstrated enthusiasm about working on a creative project and were able to submit products of outstanding quality. Although some of the students sometimes met on campus to coordinate their efforts, the final arrangements were made online. Documenting his experience, one of the face-to-face students said:

The project experience was very positive considering R. lives in Colorado and both J.H. and J.R. were part of the online format of the course. Even though T. and I were the only students who saw each other in class, we all kept in touch with one another regularly through e-mail and chats. We learned a lot through the course and found that online interaction and multimedia were great assets to our education.

Conclusion

This study demonstrates that online education has the potential to transcend the traditional nature of face-to-face teaching and include a larger community of information resources, content material and people. Instructors are now able to shift more control to the students and become facilitators of learning, helping students construct understanding within a more authentic context. Our experience also suggests that both off-campus and campus students can benefit from online collaboration because they all have the opportunity to interact in a knowledge building community that is not limited by time or place.

This paper presented a hybrid course framework that seamlessly integrated a traditional course plan designed for on campus students with an online course plan designed for distance learning students. Our study indicates that successful implementations of such hybrid course designs depends on:

- The ability to structure the course in such a way that no group of students gets an added advantage or benefit.
- The ability to foster interaction between both face-to-face and distance learning students based on their ideas and stance on critical issues rather than physical proximity.
- The ability to maintain focus on course content rather than the technology associated with the delivery of the course.

The Internet provides an increased range of human capabilities that will result in dramatic changes in the way we teach and learn. The model presented in this paper proposes a radical departure from the typical university model. It is centered on students and is open and diverse, while at the same time the instructor is delegated to coaching students in the pursuit of instructional goals. It is our hope that in the near future traditional university models will give their way to such innovative teaching and learning practices.

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Building Infrastructure for Mobile Software Agents

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ABSTRACT: Mobile software agents are becoming increasingly more and more popular. To be widely used, mobile agents require a specific infrastructure that supports naming, resolving names to IP addresses, docking stations to suspend agents sent to machines that are off-line, and authentication. This paper describes the Agent Naming System, ANS, which provides all these necessary facilities. We are planning on using ANS for a university-wide agent system that will support various everyday activities, such as assignment distribution and maintenance of course notes.

1. Introduction

This paper describes the design and implementation of an infrastructure to support mobile software agents. Some aspects of the current research on agents were originated by J. McCarthy in the mid-1950's; the term *agent* was coined by O.G. Selfridge (both from MIT). Since then there was an explosion of research on agents, to a great extent carried out by researchers who work on Artificial Intelligence. One of the first views of an agent used in other areas of Computer Science was that of a tool to perform client-server computing by transmitting executable programs between clients and servers; see (White 1994). In other words, the idea was to move the code closer to its data, or move the agent from a client submitting the request to the server, which is capable of satisfying this request. Therefore, originally *mobility* was considered to be the most important consideration. "Mobile" is a term that can also be applied to computing devices. For example, a user who travels with a desktop computer and connects to the network at various sites, is considered to be a mobile user. In the world of mobile users agents, one has to consider various issues that are not present in "standard" programming. First, a stationary user is identifiable by her or his IP address; specifically, they are assigned a URL, translated by a service called DNS to the IP address; see (Paul 1998). A mobile user does not have a permanent, or static IP address; instead they are assigned a dynamic IP address every time they login to the network. This means that we can no longer rely on URLs (and DNS) to identify a mobile user, and we need an alternative naming service. Second, mobile users are involved in what is called "disconnected operations" (attempted on an off-line site). Therefore, one has to consider a situation where a mobile agent is sent to the destination that is currently off-line.

In this paper, we describe a design and implementation of an Agent Naming Service, ANS. ANS provides a naming service that can be used to identify mobile agents, and includes docking stations, DS that are used to "dock" agents sent to destinations that are currently off-line (the concept of a docking station was first introduced in Agent-Tcl, the system designed and implemented by R. Gray, see (D'Agent 2000)). Our design is quite general, although we are planning on using it in a environment of a size of an organization like Acadia University (approximately 4000 students), to support distribution of assignments, course notes, etc. Our current implementation uses Aglets, the agent system from IBM, see (Aglets 2000), but it can be easily moved to another agent system, such as Voyager, see (Voyager 2000).

We introduce in Section 2 some basic terminology and discuss naming services and security issues. Then, we describe the functionality of ANS and DS. Section 3 is on implementation; it also briefly compares ANS and the well known Domain Name System, DNS. Finally, Section 4 provides a description of future work. (Our paper does not attempt to describe agents; the reader can find many papers that provide such a description; for example, see (Willian 1997).)

2. Agent Name Service and Docking Stations

2.1 Basic Definitions

In this section, we introduce various definitions used in the remainder of our paper. Mobile agents live within places; a **place** is a programming system used to operate on agents, for example to create, dispatch and retract them. An **Agent Naming Service**, ANS associates names with *places* rather than with computers; a single computer may have several places running. Here, we consider computers that may or may not have a static URL or IP address. The user of ANS knows names of places and sends an agent to a place, using this place's name. A **simple name** is a string of letters, of limited length; for example `owl`. A **composite name** (or briefly, a name) is a sequence of simple names, separated by "."; for example `owl.cs.acadia`. Components of a composite name are interpreted as place names; for a composite name consisting of two simple names, the first name is said to be **bound** by the place specified by the second name. For example, for `owl.cs`, `owl` is bound by the place `cs`. This relation can be pictured as a father-child relation, and names can be represented by trees; here we will assume that there is a single tree, the root of which is called the **root domain**, denoted by an empty string ''. The association of a name with a place is called a *binding*; removing this association is called **unbinding**. **Resolving** a name is used to identify the place associated with this name; specifically to identify the current IP address of the computer running the place as well as the port number for this place (in what follows, by URI we will mean a pair <IP, port number>). Each place maintains a **repository** of places that have been bound to this place (for details, see Section 2.2). ANS provides operations to bind, unbind and resolve names, by maintaining a tree of places. For example, if a place wants to send an agent to another place, called `owl.cs`, ANS will resolve this name (`owl.cs`), and if this process is successful, the originating place will be provided with the URI of the destination place.

In the world of mobile agents, we have to be able to authenticate these agents. For example, when an agent is sent from `owl.cs.academic` to `hawk.chemistry.academic`, the destination place will want to verify that this agent has actually originated from `owl.cs.academic`. An *authentication* is the process of verifying the identity. The simplest authentication protocol is based on hostname or IP address, and it is not acceptable when dynamic IP addresses are used, specifically when clients are mobile. In addition, IP- and DNS-spoofing can be used, see (Stein 1998). HTTP *basic authentication* assigns a user Id and password with each node of a file system, but the password is transmitted using a simple base-64 encoding and therefore it is not safe. *Digest authentication* uses a more sophisticated encryption, but requires that the encoded data is stored in secure storage, because access to this data gives immediate access to the information. The best technique for authentication is to use cryptography; specifically a public key system, see (Scott 1999), and ANS uses this technique.

2.2 Functionality of ANS

The design of ANS is based on the design of a Domain Name Server, DNS, (for the description of DNS, see (Paul 98)). DNS supports a similar namespace, but its techniques used for traversal of the name tree differ from these used in ANS (details are described in (Muldner and Thian Tin 2000). As we indicated above, ANS can be represented as a tree, where each node is labeled by an atomic name, and the root is labeled by the empty string; see Fig. 1. Note that the tree structure of ANS represents an organization structure of places involved in it; for the example in Fig. 1, we have two departmental places, with other sub-places representing offices and faculty members. The composite name of a place M is then created by taking a path from the node associated with M and going to the root (names in this path are separated by "."); for example,
`John.Dr_SmithSmith.Computer_Science` is a composite name for a place `John`.
Places can accept new bindings and are used in resolving names; leaves represent places that have names but currently do not bind other places. For example, in Fig. 1 `John` is the name of a place bound to the place

`Dr_Smith`; which in turn is bound to the place `Computer_Science`. Initially, only the root place exists, and it is allocated a static IP address, so that it can always be accessed by other places. Each place maintains two repositories, called respectively the main repository and the cache repository (both repositories are described below); and it also has a factory of public keys used for authentication.

A place may be in one of two modes: accepting (registration), and non-accepting (registration).

The **main repository** of a place P stores information about places currently bound to this place, and provides the interface consisting of the four accessor functions and two modifier functions:

`getName(name)`, which is used to determine if the `name` is bound to the place P;
`getURI(name)`, which returns the URI associated with this `name`, or `NULL`;
`getKey(name)`, which returns the public key associated with this name
`getParentURI(name)`, which returns the URI of the parent, (the place where P is bound), or NULL
`setURI(name)`, which updates the URI associated with the name
`setParentURI(name)`, which updates the URI associated with the parent.

The URI stored in the repository has a Time-To-Live, (TTL) attribute; the value of this attribute is set by the place. When this time expires, the URI is made invalid, that is set to NULL.

A place also maintains the **cache repository**, which stores composite names and the corresponding URIs of the corresponding places (for the description of how this cache is maintained, see below). Each entry in the cache repository has an associated TTL.

Now, we will explain the operations supported by ANS. All these operations are performed by sending agents from one place to another; see Section 3. Operations may be delayed by sending an agent to a docking station; see Section 2.3.

2.2.1 Binding

A place P registers with ANS by submitting a binding request to another place Q. The place P uses its key factory to provide a public key K, and an atomic name N it wants to use; for example `"owl"`. The request may fail because Q's ANS name is incorrect or Q could not be reached, Q is not in the accepting mode, the submitted name is incorrect or in use, or the public key is not valid. If the request is granted, P will be bound to Q (in a tree, P will become a child of Q). The public key K is stored in the place Q and will be used for any future authentication of P. The repository of the place Q will also store the name N, and the current URI of P.

2.2.2 Unbinding

A place P removes its registration with ANS by submitting and unbinding requests to another place Q. This request includes the name N, and the public key K. The request will fail if Q could not be reached, the place P is not bound to the place Q, or its authentication failed. As a result of unbinding, the place P will not be registered with ANS, and therefore it can not be resolved.

2.2.3 Resolving

A place P, which wants to send an agent to another place Q, must know Q's composite name in the ANS (for example, `John.Dr_Smith.Computer_Science`). Resolving this name results in finding the URI of Q. Resolving does not include authentication, this is a separate operation (see below). For example, consider the place `Ming.Dr_Smith.Chemistry` that wants to send an agent to the place `John.Dr_Smith.Computer_Science`. The resolve request is sent up the tree, one node at a time; in our example, first from `Ming` to `Dr_Smith`; then from `Dr_Smith` to `Chemistry`, and finally from `Chemistry` to the root. (Note that the request is not sent from the originating place directly to the root, because such strategy would overload the root with requests). Once the traversal reaches the root, it starts descending down the tree towards Q; in our example moving first to `Computer_Science` and finally to `Dr_Smith`. If the traversal successfully reaches the destination place, then the URI of this place is returned as a result of the resolving request. During the traversal, each node's cache repository is queried, and if it contains URI for the Q's composite name, then the traversal is stopped and this URI is returned. If at any time, this traversal fails (because the URI of the parent is invalid), then the resolve request fails.

2.2.4 Changing Name

A place may request a change of the name under which it is bound. For this sake, it will issue a Change name request, which is similar to the binding request, except it also provides a new name.

2.2.5 Updating URI

When a place P registered in ANS changes its URI, for example it moves from one computer to another, it may submit its new URI to all children of P, so that they can update their parent's URI

2.2.6 Updating cache repository

The cache repository is updated whenever there is an opportunity to record a new URI, or invalidate the existing URI. Specifically, while resolving and traversing the path of the ANS tree, the cache repository of a node N may contain the name of the destination place. If the attempt to use the associated URI fails, then this entry is removed from the cache repository of N, and the traversal continues. If the traversal has successfully terminated, the name and the URI of the destination place is stored in the cache repository of the originating place.

2.2.7 Authentication

Authentication is performed when an agent is sent, so that the place Q that receives an agent could check that the request is coming from the place P that sends the agent, and the place P could check that the request has actually been submitted to the place Q (note that the URIs of these places may dynamically change). Consider again the place `Ming.Dr_Smith.Chemistry` that wants to send an agent to the place `John.Dr_Smith.Computer_Science` (see Fig. 1). In order to check that the agent arrived from the place `Ming.Dr_Smith.Chemistry` we use the `Ming` 's public key stored in `Dr_Smith`'s repository, and in order to check that the agent arrived to the place `John.Dr_Smith.Computer_Science` we use the public key stored in `Dr_Smith`'s repository. Specifically, the agent is originally encrypted with the private key that belongs to `Ming`, and then when it arrives at `Dr_Smith` it is additionally encrypted with `John`'s public key.

2.3 Docking Stations

When a place P tries to contact another place Q, using Q's URI, it may fail for two reasons. First, the system running at Q's URI may fail to authenticate P. Second, the destination place Q may be off-line. In the latter case, the request does not automatically fail; instead it may be redirected to a docking station.

A docking station, DS is a place running on a computer that is "never" off-line (unless it failed; for example has become inaccessible). This computer may or may not be a static IP address. Docking stations can be incorporated into ANS using two techniques. Using the first technique, docking stations are allowed to be bound only to the root, and not to other places, because these places may be temporarily inaccessible and docking stations should be "always" accessible. For the example in Fig. 1, there may be a docking station associated with the `Chemistry` place and another docking station associated with the `Computer_Science` place, but both docking stations would be bound to the root of ANS, and will only internally store the associations to ANS names. Therefore, the root place will maintain the list of docking stations, and for each docking station there is a list of places this docking station is associated with. The second way of incorporating docking stations into ANS is to treat them as any other places; this solution is practical if we assume that non-leaves of ANS are never off-line. Each place has a cache, called the DS cache that consists of two URIs: the sender and the receiver docking stations (these concepts are explained below).

Now consider a place P sending an agent to another place Q, which is currently off-line. The place P consults its DS cache; if it is valid then it retrieves the URI of the docking station. Otherwise, P asks the root of ANS to provide the URI of the docking station that can be used by P. There may be several such docking stations, because every docking station associated with the predecessor of P will qualify. In this case the URI of the docking station associated with the closest predecessor is returned (and stored in the DS cache for future use as the sender's docking station). If no docking station is available for P, then the action of sending an agent from P to Q fails. Otherwise, P will send the agent to the docking station, where it will wait until the destination place comes on-line. A DS has a policy that determines how places may register, and live in the docking station. For example, this policy may state that no more than five agents are present, how often the docking station checks if the destination place has become available (here called, time to ping, TTP), time to live, TTL, etc.

When an agent arrives at the docking station, its identity (ANS name) is recorded, and the agent is deactivated and stored in persistent storage. When a TTP expires, the docking station contacts the destination computer and checks to see if the destination place Q is on-line, and if so activates the agent and sends it to Q. Otherwise, DS tries after another TTP time, and if the TTL time has expired it assumes that the sending of the agent has failed.

Frequent pinging is not necessarily efficient, and therefore a docking station provides an alternative policy, called the notification policy, where the destination place has to perform the required actions. The agent sent to the place Q brings the URI of its docking station D, and the place Q has the option of saving it. If Q chooses to use this information, the docking station D is notified to switch from the ping policy to the notification policy. Now, when Q comes on-line it will ask the docking station D to send any agents waiting to come to Q. Note that agents suspended in D have their TTL, and if this time expires and the current policy is that of notifications, then D will extend the TTL, and switch to the pinging policy (giving the agent another chance to be delivered).

3. Implementation of ANS and DS

Our current implementation uses Aglets, the mobile agent system from IBM, see (Aglets 2000). However, our design is quite generic and we are in the process of moving the implementation to another well-known agent system Voyager, see (Voyager 2000). ANS has been implemented by sending agents, for example verification agents, binding agents, and so on. In the current version, we assume that all places that are not leaves are always on-line, but the next version (that will be completed in early Spring 2001) will not make this assumption. Below, we show several screen shots representing ANS in action. The main screen for using ANS operations that can set up a place is showed in Fig. 2.

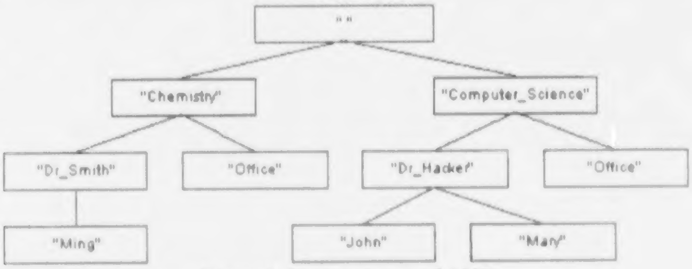
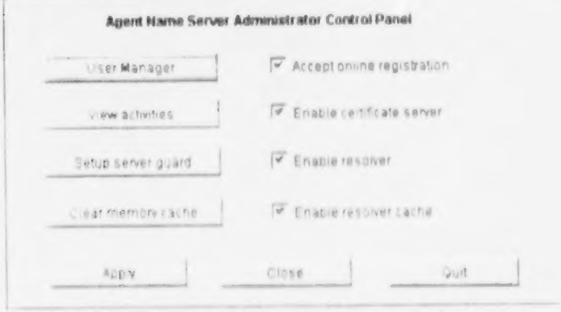


Figure 1: Tree structure of ANS



☑ Accept online registration
☑ Enable certificate server
☑ Enable resolver
☑ Enable resolver cache

Figure 2: Agent Name Server screen shot.

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4. Future work

In our future work, we intend to implement another version of ANS, using the Voyager mobile agent system, and we will compare these two versions. We will test various algorithms and compare them for reliability and efficiency. In particular, we will compare ANS-based systems with non-leaf nodes that are never off-line with other kind of systems, in which non-leaves are allowed to go off-line. We will also compare various caching techniques, for example caching URIs, public keys, etc. Finally, we will complete our work on an application of ANS to a university-wide agent system that will support distribution of assignments, course notes, etc.

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To measure or not to measure:

Why web usability is different

from traditional usability.

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Abstract: Web usability is a common term used in discussions of WWW (World Wide Web). This is definitely important, as more and more web sites are frequently visited and have great impact in the new economy, the network economy.

However, research lack in consistency in defining 'web usability'. Some point out that the term is equivalent with the traditional term in HCI (Human Computer Interaction) research. Others point out the differences with traditional usability and do this with comparisons between the two.

This article discusses the concept of usability in general as well as the notion of web usability and their relation. Further, a conceptual model is built to facilitate how to handle usability aspects on the web. This model is then exemplified with two examples of web sites. Here, the importance of choosing the right categorization is clear. The sites are both e-commerce sites, however, they show upon clear differences when it comes to usability aspects.

Web usability is an important issue when it comes to design of web sites. We have to start to take it seriously.

Key words

Usability, web usability, world wide web, www, the web, e-commerce, learning environments

Introduction

As the World Wide Web (www or just 'the web') continues to grow, as if out of control, the need for a discussion around usability aspects on the web emerges. So far, in relation to the number of web sites, the usability aspects more or less have been left out. One explanation of this phenomenon may be the fact that web designers are working as quickly as possible. They do so in order to build as many web sites as possible because of the overheated demand and therefore do not have time, or simply do not need, to usability test their designs. This may though be a very simple explanation on a more complex problem. The fact is, even if designers on the web wanted to call for backup in usability engineers to do usability testing on their sites, problems occur simply because of the nature of the web. Below, aspects relating to usability on the web are shown:

First, this medium is quite new. We know very little about how to design for hypermedia, as the technology behind the scene is called. New ways of structuring information is needed, and this has to be tested. Right now, users get frustrated when things do not work out the way they are used to (Nielsen, 1999). Standards and guidelines have not yet settled in web design and more, the hypermedia type of technology requires special types of features (Spool et al, 1999). Second, the group of visitors is heterogeneous as the medium is public and this makes the feedback on poor design difficult to reach. For instance, as long as the purpose of the users is diffuse, we do not know what to measure. One site could also have many purposes as selling, reviewing articles, entertainment and more

(Schneiderman, 1997). Third, the group of web designers is also heterogeneous. The reasons for this are the growth of the web as well as the ease of access to facilitating web design. (Bevan, 1998). Design professionals are of course a big group, but in general almost everyone can design web sites. This makes emergence of standards and guidelines difficult (Nielsen, 1999). Finally, the technology is in its nature heterogeneous. Platforms, browser types and versions, html versions and more, make the design a complex issue. The medium was at first mainly intended to be used for academic markup language for distribution of texts in networks. Nowadays, interaction designers create interactive 3D games for the web, and layout is perhaps the most discussed topic in web design. HTML is simply not suitable for this type of usage.(Mayhew, 1998)

People leave web sites all the time because of usability aspects, as they get stuck, and they may never come back. Web usability is different than usability in general, but how do these two concepts relate and how do they differ. That is what this paper discusses.

In order to discuss this usability as a more general concept is first discussed. This is then compared with related work around web usability. What have been said about the concept web usability itself, and what types of studies have been conducted. A framework of how to handle issues of web usability is conducted based on earlier discussions. To test the reliability in the framework, exemplification have been conducted upon some web sites. Finally, this is discussed and further research is exemplified.

The concept of usability in general - some key points

Usability is a key concept in HCI. It is concerned with making systems safe, easy to learn and easy to use (Preece, 1994). The term usability may in daily talk suggest something it is not. Below, a figure showing usability and its context is displayed. Note though that this is one of many categorizations of usability. (For further readings, c.f. Dix et al. 1998)

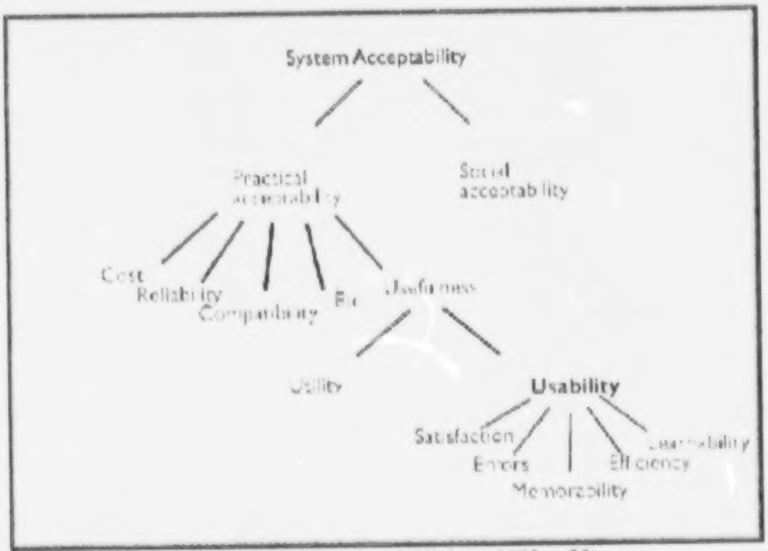

Figure 1: The context of usability in general (Nielsen, 1993, p.25).

In short, descriptions of some of the general concepts above are: (For the interested reader, it is explained at pp. 24-25 in Nielsen (1993).

- System acceptability. Whether the system is good enough to satisfy all need and requirements of all stakeholders, from direct users to customers and more.
- Social acceptability. Whether the system correspond to social rules and norms in the context.
- Practical acceptability. Acceptability according to categories as cost, reliability, compatibility with other systems, usefulness and more.
- Usefulness. Is the issue of whether the system can be used to achieve some desired goal? Can be broken down into utility and usability.
- Utility. A question of whether the functionality of the system in principle can do what is needed.

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- Usability. A question of how well users can use the above functionality.

Further, Nielsen (1993) defines usability as containing at least the following aspects:
1. Learnability: The system should be easy to learn so that the user can rapidly start getting some work done with the system.
2. Efficiency: The system should be efficient to use, so that ones the user has learned the system, a high level of productivity is possible.
3. Memorability: The system should be easy to remember, so that the causal user is able to return to the system after some period of not having used it, without having to learn everything allover again.
4. Errors: The system should have a low error rate, so that users make few errors during the use of the system, and so that if they do make errors they can easily recover from them. Further catastrophic errors must not occur.
5. Satisfaction: The system should be pleasant to use so that users are subjectively satisfied when using it; they like it.

Usability tests may be conducted in numerous ways, including all from one single technique to a whole repertoire of approaches. It is important to be aware of what to measure. Two common approaches to measuring usability are the following (Redmond-Pyle & Moore, 1995):

- Performance tests, where users use the system to perform a task, and their effectiveness are measured. Common measures are speed, accuracy and/or errors.
- Attitude surveys, where user satisfaction and user perception of the software is captured. Common ways of capturing data are questionnaires or interviews.

Web Usability - related work

Related work around web usability is divided into two general groups; (1) Methodological papers, where methodological issues related to the concept 'web usability' is discussed, and (2) Reports around results from web site usability tests, with more brief discussions around how to generalize results and more.

Examples of the former are:

Schneiderman (1997) discuss usability aspects related to the web and says that, as in any media, criteria for quality vary with the genre and author's goals. His idea is that there are some web-related criteria that may be seen as more general, like visual appeal, comprehensibility, utility, efficacy and navigability. However, he continues to warn about these high-level goals and point out that a categorization of the web is needed to find more fulfilling criteria to test. The problem though is to find bases to categorize from. Schneiderman gives some examples:

- By originator's identity. Individual, group, university, corporation, nonprofit organization or government agency.
- By the number of web pages in the site. A similar way is to look upon the amount of information on the site.
- By goals of the originators, as interpreted by the designers. Here, the spectrum is wide. From a personal file with chaotic structured information to impressive organizational annual reports. Further, as commercial sites start to grow elegant product catalogs and lively newsletters will be the norm. Web-zines - magazines on the web, digital libraries and much more, all make different kinds of criteria, as well as special usability needs.
- By measure of success. For individuals, the measure of success for an on-line resume may be getting a job or making a friend. For many corporate sites, the number of visits measures the publicity. Further, for others, the value lies in the amount of sold articles from the site. Other measure success in diversity in hits or hours spent on site. Example of the latter may be entertainment sites.

Another work done in this research direction is a discussion around how web sites have other kind of characteristics than traditional interfaces (Laskowski & Downey, 1997).

Gaines et al. (1996). Discusses dimensions of problems on the web and try to categorize sites from the concepts of utility and usability. They come up with a layered framework. The article is not further discussed here, though it is interesting work.

Ratner (1998) tries to come up with some conclusions around novice and expert users in learning environments using Netscape. She stresses that even if the goal of the educators, have a specific goal and that the students seem to be a homogenous group, they are not. This must be taken into account in design of such web based learning environments.

Examples of the latter types of related work might also be divided into two subgroups.

So far most usability studies of web sites have focused mainly on efficiency aspects (e.g. the time it takes for a user to find a piece of information in a relatively large site).
Information retrieval is the far most common target for usability testing at web sites. This is because this activity often is seen as central at the web in general (Spool et al, 1999).
Usability tests may be conducted in numerous ways, including all from one single technique to a whole repertoire of approaches. It is important to be aware of what to measure. Two common approaches to measuring usability are the following (Redmond-Pyle & Moore, 1995):
1. Performance tests, where users use the system to perform a task, and their effectiveness are measured. Common measures are speed, accuracy and/or errors.

An example of this is Borges et al (1996)and Borges et al (1998), where they first conduct heuristic evaluation on a number of university sites. Re-design of some of them are then conducted and finally task analysis is done where users are measured when doing tasks. The usability team then ended up with a list of guidelines as a result of their test. However, they are very strict to tell upon the narrow spectrum of web sites these guidelines are appropriate support for design.

2. Attitude surveys, where user satisfaction and user perception of the software is captured. Common ways of capturing data are questionnaires or interviews.

A typical example of this is Spool et al (1999) and their huge usability test of big corporate sites with main focus on e-commerce. This report, or more book, covers the study of nine sites, and here the tests are much more wide. Instead of using the clock in measuring, the test team uses interview forms before and after combined with observations. The users got tasks, but interrest was more put on ways of finding information, instead of how quickly the information was retrieved.

Grose et al. (1998) shows with a two folded studie that web style guides differ from traditional style guides and stress the fact that this must be investigated further.

These examples shows how usability engineers handles these aspect in different ways. In the next section, we should create a framework for usability in order to quicker grasp how to conduct tests.

A framework for web usability

In order to come up with the differences between usability in general and web usability, the notation of describing usability in general, is used. This notations is combined with Schneiderman's discussions around categorizing of the web. Below the concept is displayed:

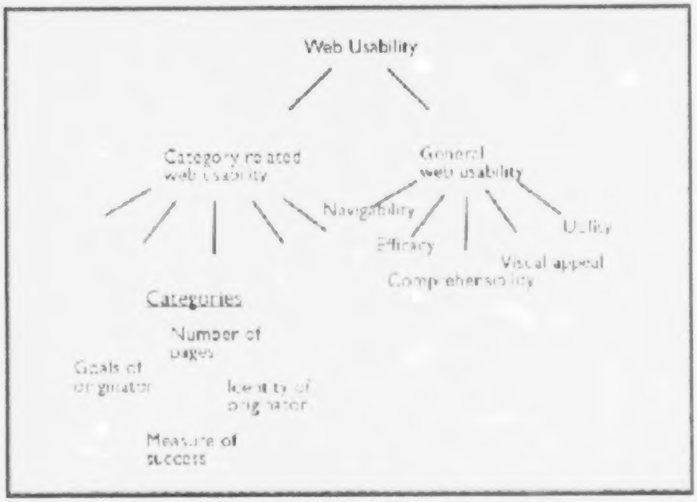

Figure 2: A framework for web usability.

BEST COPY AVAILABLE

This framework is below tested with two e- commerce web sites, Amazon.com (figure 3a), widely known book store and the 'Robinson' web site (figure 3b), a support site for a famous TV-show at Swedish Television. The two sites may be categorized similar because of the fact that they both are different kinds of e-commerce sites. However, if other types of categorizations are used, differences start to appear.

For instance, if the measure of success is used, the first, Amazon.com might measure the success in amount of sold items. Another success for them might be amount of hits, as they sell a lot of banners on their site. The Amazon site is difficult to categorize as it is very wide. The company have many purposes with their popular site. Depending on what activity on the site we are designing/evaluating, we must focus on different measures. This, the above figure might help us with.

The 'Robinson' site is quite different. As mentioned, it is a entertainment site, tightly connected with a TV-show. The show is a kind of reality soap opera and on the site you can find supporting information as gossip about the 'actors', screensavers, competitions and more. Also, the design of the site is very different from the Amazon site. On Robinson site there are sound and moving pictures. Overall it gives a very 'Flashy' impression. To test this type of site, time measures are useless. The goal from Swedish Television as well as their measure of success focus more upon high rates of hits, as well as to get the visitor to stay for a while. The visitor on this site want to explore a suprisingly mysterious site and stay for a while. That goal of the designers as well as Swedish Television is quite clear.

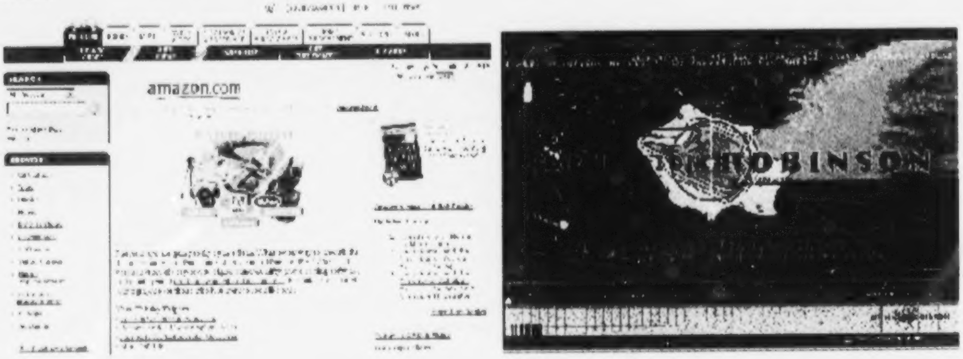

Figure 3: Screenshots of a)Amazon.com and b) Expedition Robinson at the Swedish Television.

Conclusions

Usability on the web is different from usability in general. These conclusions we draw from combining different discussions around the subject and then testing it. The figure of web usability should be used as a guide in order to come up with the proper usability tests and when finding out what the proper measures are. In our cases, with two e-commerce sites, it is clearly shown that they require different measures. This, even if they may be put in the same category of identity, large corporation. In this case a categorization based upon goals of the originators or measure of success may be better. So, what this test and discussion show are:

- Web usability is different from usability in general.
- Categorization of web sites may be a good way go get/give guidance when discussing web usability.
- The way we categorize web sites show strong implication in the way we test usability.
- The built model can give some guidance in the work around usability on the web.

Future work

Tests have to be conducted with focus upon the relation between web usability and different categorizations of the web. A research question in this could be; How do the same type of web sites relate in usability aspects and what categorizations are fruitful for this purpose, e.g by genre, by technical aspects or by size of the site. This is interesting because of the need for general guidelines. If, and in that case what, do educational web sites have in common when it comes to usability aspects? Are the technical aspects, as usage of frames for navigation, critical in design for the web? Regarding to usability aspects, how should we categorize the web?

As we do not really know much about these relations yet, this will be important feedback in the debate and research of web usability.

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Authenticity of Situated Cognition in Web-Based Instruction Environment - Potentials

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Abstract: Situated cognition operates under the framework of constructivism. Authenticity is one of the elements that situated cognition promotes for effective learning. Authenticity means to conduct instruction/learning in actual settings. But various factors reduce the feasibility of learning at work. Alternatively, information technology, Web in this case, provides a venue through which authentic learning could be conducted. The practice of an IT course offered via web at a Canadian university is recollected to explore the possibilities of authentic learning in Web-based instruction.

Introduction

Situated cognition investigates persons acting within complex social and material contexts (Kirshner & Whitson, 1998). Situated cognition stresses the significance of learners' participation in the learning process and, more importantly, the placement of that learning experience in a real world situation. Authenticity, learning context, enculturation, collaboration, cognitive apprenticeship, scaffolding, etc. are elements in situated cognition that promises effective and robust learning. They all call for the learning that mostly happens in the concrete, dynamic, and face-to-face environment.

On the other hand, technology, information technology in particular, are "dramatically transforming" our knowledge acquisition and "automating the component processes of thinking and problem solving" (Pea and Brown, 1991, p. 12), as has been witnessed. Information technology has been increasingly used for learning and instruction. As a new medium for information storage and transmission with "innovative technology tools and features" (Bonk and Reynolds, 1997, p. 117), information technology, the World Wide Web (Web) in particular, is redefining the meaning of learning and understanding, and to an increasing extent, how learning takes place. It is seen as one of the most promising tools to change an individual, a group, or even a nation's fortune.

Situated cognition: One element of constructivist learning

Constructivism theory is based on the work of educational philosopher John Dewey, and educational psychologists Lev Vygotsky, Jean Piaget, Jerome Bruner among others. Constructivism sees learning as a process and that individual learners actively construct knowledge in the process, based on their prior and/or current knowledge (Kearsley, 1999). Constructivism advocates that learning takes place in a problem-solving and realistic environment. Situated cognition operates in constructivism framework.

Situated cognition is an alternative perspective in understanding learning. Literally, situated means circumstanced, or of a person in relation to circumstance (The Oxford English Dictionary, 1933; Webster's Third New International Dictionary of English Language, 198). In learning theory, situated means positioned. It is interpreted as positioned in relation to circumstance between self and other in the world of social affairs (Cobb & Bower, 1999).

Situated cognition investigates persons acting within complex social and material contexts (Kirshner & Whitson, 1998). Situated cognition stresses the significance of learners' participation in the learning process and, more importantly, the placement of that learning experience in a real world situation. "Situated activity," Lave & Wenger (1991) maintain, implies "emphasis on comprehensive understanding involving the whole person rather than 'receiving' a body of factual knowledge about the world on activity in and with the world; and on the view that agent, activity, and the world mutually constitute each other." (p. 33)

Situated cognition recognizes the dialectic relationship between knowing and doing, and argues that learning activities and the context in which the learning activities are carried out have impact, many times great impact on our cognition and learning (Brown, Collins, & Duguid, 1991; Choi & Hannafin, 1995). Instead of traditional rigid and incomplete understanding through learning structured and decontextualized factual knowledge in classroom, therefore, situated cognition promotes understanding through concrete and authentic learning tasks. In situated cognition, the context where authentic learning takes place and the culture that defines the context necessarily exercise great influence on the kinds of learning that is engaged and fostered within that context (Carr, Jonassen, Litzinger, & Marra, 1998). Learning and cognition in situated cognition are seen to be fundamentally situated and that situations co-produce knowledge through activity (Brown et. al, 1991).

As one key element in situated cognition, authenticity calls for the learning that mostly happens in the concrete, dynamic, and face-to-face environment. Authenticity connotes the construction of individual knowledge through interaction between the individual and the real and concrete learning activities. It acknowledges influence the learning/working environment exerts on the learners. As Bransford, Brown, & Cocking (1999) point out, recent work in the social psychology, cognitive psychology, and anthropology supports the view that learning and transfer are influenced, in a powerful way, by the particular settings in which the authentic learning takes place.

Authenticity

Authenticity is closely associated with the genuine and concrete activities taking place at real life settings. Particularly, authenticity deals with the issues or problems arising from the actual work or activities that need be dealt with or be resolved. Savery & Duffy (1995) explain authentic learning as the activities that represent the same type of cognitive challenge as those in the real world. Jonassen (1999, p. 221) sees the authentic activities as the learning tasks that "replicate the particular activity structures" in real world. Authentic learning thus involves the accomplishment of activities that are commonplace in the daily problem solving situations of the just plain folks (JPF), practitioners, and experts (Brown et. al, 1991; Choi & Hannafin, 1995; Wilson, 1993).

A striking difference between school students and JPFs/practitioners is the location where learning activities (problem solving activities) are conducted. At school, students are traditionally engaged in classroom learning of textbooks and other forms of instruction materials that have been edited, i.e., simplified to better 'suit' the students.

On the other hand, the JPFs/practitioners deal with problems occurring right in their work. Those problems appear as they are, with little human manipulation to simplify or to make them easier to solve. Often, the real life problems seem in disorder and are accompanied with background noise. People have to follow them closely to search for clues, to work out possible solutions, and to try to solve them accordingly while they have to solve them promptly. Unlike the problem solving in classroom where time and steps are pre-planned nicely so that things appear in a linear fashion, the process of problem solving in real world is often nonlinear, i.e., many elements of the problem are random and emerge in the process of solving the problem (Greeno, J.G. and the Middle School Mathematics through Application Project Group, 1998) while they must be solved promptly. The process of solving the problems may appear informal, they are nonetheless "full-blooded, authentic activity that can be deeply informative in a way that textbook examples and declarative explanations are not" (Brown et. al, 1991, p. 35).

Situated cognition promotes the engagement of learners in authentic activities in real world problem solving. Further than simply acquiring factual knowledge, the learners need to know what is the use of the knowledge - they need to know why they should care knowing about it. In other word, they should have the ownership of the problem or learning goal (Jonassen, 1999, Nelson, 1999; Schank, Berman, & Macpherson, 1999). With the ownership, the learners feel it genuinely their problems, not others because the problems arose from their learning or from their work. They consequently feel the necessity, obligation, and motivation to solve them as the solution will have immediate impact on their learning work. Often, hands-on, concrete, relevant learning activities enable the learners to acquire such ownership and to derive personal understanding, consequently.

Taking the students to various settings in life for problem solving is a solution to authentic learning. This may well allow them to witness, own and consequently solve real world problems. Yet it is often too costly to do so because of the resources involved. Besides, and perhaps more importantly, it is often the case that much time is needed for a novice to really immerse in a new setting. One needs time to become familiar with new environment and get accepted by the old-timers in the new surroundings. A practitioner/JPF may sequester an outsider from solving his/her problem because of legitimacy (Lave & Wenger, 1991).

Even if time is sufficient for students to learn in real life through problematic cases, and there is no such issue as legitimacy, the problematic cases are not always available – one cannot be in the right place at the right time all the time. The chances are that what is available may not be what the students need to learn. Taking students to living settings is therefore not the most feasible way for authentic learning.

An alternative is to incorporate the problems into textbooks for the students to solve. We could present more living examples for students to refer to for the development of their problem solving ability. Because of the nature of the print (i.e., still, silent, mono colour, etc.), however, much dynamic and living elements and peripheral information in living world are lost in print representation.

Other feasible alternatives are needed. We need to gather those live cases and make them ready for students. But we need to have the proper format to prepare and represent those cases while keep their vitality and originality. We need a medium that can not only record but also represent dynamically the live cases for authentic instruction/learning. Print possesses some but not all the features for our purpose. Something else must be found that can represent living scenes as closely as they are for students' authentic learning. Educational technology, Web in particular, is one of the tools that can play such a role.

Authenticity in Web-based instruction

With Web-based instruction, authenticity could still be reached without having learners go to the actual site to do their work or to participate in the activities. In the Web-based instruction, the features of modern technology could represent the issues and/or problems as they such, i.e., as they occur in actual settings, allowing the learners to deal with or to resolve those issues and/or problems as if they do in real life. Though not learning face-to-face, the learners in Web-based instruction can still communicate with each other, and with instructors. They can still ask questions and seek help, and they can still comment on peers' work. Web-based instruction is able to do so because of its multimedia features and its computer conferencing communication tools.

Multimedia, such as (digital) video, computer simulation, etc., with its sound, color, still and motion visual display, and verbal capability, is able to represent genuine real world activities (CTGV, 1992; Gabe & Grabe, 1996; McGinn & Roth, 1999; Szabo & Poohkay, 1996;). Similarly, cases of unsolved real world problem could be incorporated into online courses for students to resolve. The computer conferencing, on the other hand, enables learners to participate actively in solving real life problems represented through multimedia, by putting forward their solutions, or commenting on peers' work.

Such authentic learning activities online have actually been practiced, though on a limited basis, at some of the University of Alberta's online courses, including some educational technology courses for the graduate students at the Division of Instructional Technology, Department of Educational Psychology (i.e., 500s EDIT courses).

In one of the IT courses, for example, the learning activities are for students to study a case and then solve the problem(s) presented in the case (study). The name of the case study is Rocket Boy. It is actually an online case study linked to the course. The case is about the low productivity and un-profitability of an affiliate with a big corporation. The students are required to analyze the case, identify issues regarding the low productivity and un-profitability and address them accordingly.

The students, having been assigned to the task, read the case carefully. They went into (the description of) individual departments in the affiliate, learned their functions and responsibilities, got to know the employees in each department and their views toward the department's responsibilities and unprofitability. There were graphics, diagrams to illustrate the whole hierarchy of the affiliate, and there were also pictures and brief biographies of each employee of the department that allowed them (the students) to visit them, including their responsibilities in the affiliate.

The students analyzed the information provided (in multimedia) and reasoned why the affiliate was not only unprofitable but had been receiving subsidy from its patron corporation as well. They formed small groups, analyzed the data. They shared their ideas within their group. They discussed and debated the issues, the factors that might have resulted in the poor performance of the affiliate and of particular department. They used various sources to support their own solutions, or to argue against their peers' solutions. Often they located their supporting resources from the hyperlinked resources that had been intentionally connected to the course page.

All those learning activities were carried on through the Internet, through the computer conferencing, bulletin board, and e-mail specifically. Through discussion and debate, the students understood the affiliate's poor-operation better and put forward their solutions to the problem. Then they posted their finished work onto the conferencing board, allowing peers (in other groups) to read, compare, and comment each other's product.

Though the activities were carried out completely online in electronic format, they were as real as they could experience in reality, with the same information as they could have in real life to make sense of, and arrive at alternative solutions. In fact, in some cases the students had more information to make use of than they could have in classroom learning, owing to the vast internet resources.

Through the sharing, discussion, and debate, the students not only got better understanding of what was being done but also, and perhaps more importantly, learned how the seemingly chaotic information provided as such, could be utilized for problem solving, and how others utilized the information and other hyperlinked resources to deal with the same issues/problems, often different from their own. They were able to widen their perspective, to know how to know and to know how to learn comprehensively.

In addition to those merits, the Web-based instruction offered synchronous and asynchronous learning environment that made learning convenient for many students. Because of different habits, students worked on their courses in different time. Some students aired their opinions and commented on others late at night while others did them during the day. Web-based instruction enabled them to do so easily. Moreover, students were able to work on the course in places other than the classroom and/or library on university campus as it had no spatial requirement for what was being accessed or worked on. With computers connected to the Internet, they could work at home or at work. As some students expressed in their post on the bulletin board in the course, they enjoyed the flexibility that Web-based instruction provided very much as it allowed them to access the course any time and/or any place they wanted to.

Another point to be mentioned is that the role of instructor in Web-based instruction. As has been demonstrated in the EDIT course, the role of the instructor changed from traditional knower who transmitted knowledge to the students to that of a facilitator who provided guide for the students during the learning process. The instructor in the IT course, for example, did not judge any student work that had been posted on the conferencing board. Instead, he would occasionally join in the (online) discussion or debate by raising some questions on a specific case that might be problematic. The question often led to the students' rethinking of the ways or rationale they used for dealing with the case.

The interactions between students and between students and instructor were often thought provoking. They started, and many times forced the students to reflect on their knowing, and reflect the knowing of other people. The learning was quite positive and heuristic. Bonk & Reynolds (1997) believe that some interactive activities carried on through the web-based instruction may be the success stories of web-based instruction of the new millennium.

Conclusion

This paper derives mainly from the author's observation of online courses delivered at a Canadian university. It discusses the application of one situated cognition element – authenticity, to the Web-based instruction environment. Authentic learning activities, such as those of in the graduate courses in EDIT program at the Department of Educational Psychology, the University of Alberta, enabled learners to have first-hand experience as how a problem was solved in the (simulated) real world and what elements were involved, rather than a textbook experience that was often abstract, structured. The learners were able to reflect the process of problem solving and to ponder on why certain things had to be done while others were not, often in response to the emerging problems in particular situation, instead of pre-planned text.

Moreover, a great motivational potential was also involved in engaging learners in authentic learning activities because success or not, of a decision or an action by the learners could be immediately felt by peers as well as by oneself (Choi & Hannafin, 1995).

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Integrated Instruction as a Component of a Knowledge Management System: A Case Example

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Abstract. Knowledge management systems are in increasing demand to address the growing need for systems solutions that allow for better access to a corporation's complex knowledge and various types of information. In this paper, a case example of such a knowledge management system is presented for which an integrated instructional component was developed. The design of this component is based on an extension to Cognitive Flexibility Theory and aims to support learners with different levels of expertise and with different job functions in one integrated system.

Introduction

As business processes and procedures have become more complex, organizations are increasingly demanding customized solutions for making their information readily available to all employees. Often, however, a mere document management solution is not sufficient to solve a corporation's needs for the communication of that information to employees and customers. Instead, a systemic knowledge management solution is needed that includes, in addition to document management features, components for advanced searches, decision support, case examples and best practices as well as instruction covering the use of the documents in an integrated form.

The growth and sharing of knowledge is recognized as an important element in becoming a "learning organization" (Easterby-Smith, 1997; Marsick and Watkins, 1994; Senge, 1990). A number of different methods and tools are available that allow for this sharing of knowledge. Researchers and practitioners in the field have noted, however, that these methods and tools often lack a clear theoretical framework of how people learn and perform in an organization (Raybould, 1995). Furthermore, the few theoretical frameworks that have been developed and presented for consideration are highly abstract and lack a description of a practical mechanism for the capture and dissemination of organizational learning.

To address this situation, we have described a theoretical framework with a practical mechanism for capturing and disseminating learning at the organizational level in Salisbury & Plass (2000). This theoretical framework includes a knowledge creation process that can be used to grow and share knowledge, an essential part of becoming a learning organization. The framework relies on technology – a Web-based Organizational Learning and Information Support System (OLISS) – to assist in the capture of expertise from individuals and make it available to other members of the organization. In this paper, we will describe an extension of this framework, which focuses on the instructional component of a Knowledge Management System that is presented as a case example in the following section.

Case Example

The case example used for this paper focuses on the system of Technical Business Practices (TBPs) that is used by the U.S. Department of Energy (DOE) and its affiliates. Eight separate sites around the country (a subset of all DOE sites) participate in a variety of coordinated engineering, manufacturing, assembly, and management activities. Over the last several years, DOE has streamlined its operations in a variety of ways to make their production more efficient. In so doing, the various DOE sites have agreed to utilize a common set of TBPs that both prescribe and guide operations. Getting a potential user community of two thousand individuals at these eight sites to be aware of, and understand, the TBPs, related documents, terminology, and where to go for help has been the challenge in this case example.

Initial training efforts focused on developing introductory, classroom-based training and distributing it to representatives at the eight sites for them to customize and deliver to their own staff. However, user feedback indicated that what was needed for the long term was easy access to the TBPs and related documents; the ability to search those documents; some form of decision support that would help them through the maze of TBPs; and short, focused, "just-in-time" instruction on a variety of relevant topics.

The user community consists of an overwhelming number of people who have been working in design and development for many years. While some of these users are highly knowledgeable about how business has been or should be done, others are being asked, for the first time, to subscribe to the TBPs. Newcomers to the organization need to have an orientation while, at the same time, get a more complete picture of processes, procedures, and practices.

After considering the population demographics (diversity of knowledge and technical skills, varied locations, etc.), as well as our finite resources, we decided that an integrated system that included document management, instruction, and decision support in a responsive, easy-to-use format would be implemented to meet the needs of the user population. After performing an initial needs assessment, we found that the following problems would have to be addressed in the completed system:

Document Management
- Large number and varying formats of documents to be included
- Need for method to cross-reference documents
- Need for automated frequent updates to these documents which are 'owned' by different parties
- Customized search capabilities needed to search documents with variable granularity

Instruction
- Different job functions of employees (managers, engineers, customers)
- Different level of expertise within each job function (from new hire to senior employee with 25 years of experience)
- Need for one coherent instructional environment for all users

System Configuration Management
- System expands and grows with user's needs
- Frequent updates to existing content are necessary
- Easy-to-use tools for maintenance required

Based on the requirements of this particular case example, the capabilities and components of the Web-based OLISS were determined, see Figure 1. We will describe these components briefly below, for a more comprehensive description please refer to Salisbury & Plass (2000).

The *decision support* capability for the OLISS Web site has two types of features that benefit organizational members the most. The first one provides a guided search option for policies and practices. The second feature provides guidance in the completion of the steps of following a policy or practice. These features facilitate knowledge transfer in the organization. Experienced users provide the content expertise for the decision support capability. Users with less experience use the embedded expertise to find and follow the policies and practices. Managers, with less detailed knowledge of the policies and practices may also benefit from use of the expertise in their supervisory role.

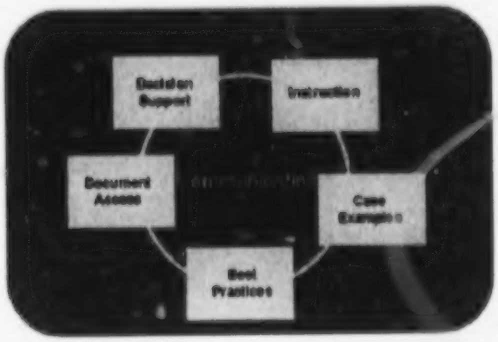

Figure 1. Components of the OLISS System

The knowledge acquisition capability of the OLISS Web site also has two types of features that mostly benefit the members of the organization. One feature is a means to organize and store *case examples*. Case Examples are general examples that illustrate the correct application of a policy or practice. Most of the time they are created for use as examples during instruction. The other feature enables the organization to store "real life" *best practices* that illustrate the correct application of policies and practices in the field. With these two features, the knowledge acquisition capability facilitates the capture and sharing of new knowledge as it is created in the organization. Managers, who are not creating new knowledge from direct application of the policies and practices, may improve their decision-making through access to this expertise.

While the other features shown in Figure 1 have been discussed in greater detail in Salisbury & Plass (2000), the next section will describe the instructional component of this system.

The Integrated Instructional Component of OLISS

The demands of the situation in the case example can be best described as learning-on-demand, which is facilitated by an EPSS (Electronic Performance Support System). The design of the instructional component of this EPSS is based on Situated Learning Theory (Lave, 1988, Wilson, 1993) and on an extension of Cognitive Flexibility Theory (Spiro & Jehng, 1990).

Situated Learning Theory recognizes the fact that learning is dependent on the activity, context and culture in which it occurs. It demands that knowledge be presented in an authentic context, a given in the case of an EPSS, as this system is used in the work environment of the learner. Situated Learning Theory also emphasizes the importance of social interactions and collaboration in the learning process. Wilson (1993) calls learning and knowing in actual situations and with authentic activities a "process of enculturation, not simply a matter of acquisition." (p. 77). He further argues that "problem solving and human cognition are carried out in conjunction with the setting, not simply as internalized mental processes" (p. 77). Others extend this idea of situated cognition to a form of cognitive apprenticeship, in which learners engage in authentic activities and social interactions in a way similar to craft apprenticeship (Brown, Collins & Duguid, 1989). For the purpose of designing the tutorials for the present EPSS, we use an approach that integrates this Situated Learning Theory with Cognitive Flexibility Theory (Spiro & Jehng, 1990).

Cognitive Flexibility Theory, as originally conceived, aims to develop the ability of spontaneous restructuring one's knowledge to adapt to changing situational demands. Spiro and Jehng (1990) argue that this

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ability depends not only on how the knowledge is represented in the learning situation; comparing, for instance, instruction with a limited number of examples with instruction that contains a large number of cases that illustrate the complexity of the concept taught. It also depends on the question whether the goal of learning is to provide learners with answers, i.e., with intact schemata that can be retrieved in order to answer a question, or whether it is to enable the learners to construct or assemble, when the situation demands it, new schemata based on other schemata stored in long-term memory (Spiro & Jehng, 1990).

Based on these two theories, Situated Learning Theory and Cognitive Flexibility Theory, the design of the instructional component of the OLISS site is tightly integrated with the other components of the system, decision support, document management, case examples, best practices and communication, see Fig. 1. The integration of these components assures an authentic learning situation where the users request instruction when they need help in order to be able to construct the knowledge needed to perform the task at hand. The reciprocal relationship between instruction and the other components, e.g., decision support and document management, results in a situated learning environment. The instruction provides assistance in the use of the components of the OLISS system such as document management and decision support, while these components in turn root the instruction in an authentic situation with case studies, examples, and authentic documents.

Extension of Cognitive Flexibility Theory

The approach described above extends Cognitive Flexibility Theory in three different ways. The flexibility of restructuring one's knowledge and assembling of schemata, which is the aim of Cognitive Flexibility Theory, results in this case study from the different access routes to the instruction and documents that are possible with this design. In other words, the mini-cases used to construct rich schemata are designed using a variety of strategies: decision support, documents, examples and case studies, and instruction. Any part of the instructional component can be accessed from the document management component or from the decision support component that relate to the topic covered. In turn, different documents or parts of the decision tree can be referred to from the tutorials to serve as examples for the instruction given. Therefore, mini-cases are provided in different strategies that facilitate knowledge construction in different ways.

A user who accesses the OLISS to seek assistance in solving a particular problem has, as described above, a variety of components available to construct a schema that will help solve the problem. Once this solution is successfully constructed, the knowledge capture feature of the OLISS system allows to add this tacit knowledge of the user into the system as a new case example or best practice. In other words, the user, who just accessed the system in need of a solution to a problem and as a leaner now acts as an author and adds the newly constructed knowledge as a new case to the system, effectively turning into a growing and changing database of mini cases. Therefore, a second extension to Cognitive Flexibility Theory as it was originally conceived by Spiro & Jehng (1990) is proposed in that the data base of mini cases is not static, but actually growing and changing with use. New information is added frequently, expanding the amount of available information for all users.

While a cognitive flexibility hypertext might be useful for expert learners, the use of constructivist learning environments with rich connections and a large number of choices for the learner is not an appropriate solution for all levels of learners. New hires or learners with little experience in a particular subject are not likely to be able to make the choices required by such a system. Instead, for these learners, a well-structured environment might provide the necessary scaffolding and guidance for the initial instruction. After this well-structured instruction has been completed, these learners can access the less-structured cognitive flexibility hypertext described above.

In order to implement this approach of different levels of control and guidance within one system of tutorials, the following sliding scale is proposed as a third extension to the Cognitive Flexibility Theory. This extension adds an introductory and an intermediary level to the advanced level of the instructional component, see Figure 2:

Introductory Level. The instruction on this level covers general information about broad topics. These tutorials are well-structured and fairly linear to accommodate the needs of novices and less experienced users.

Each topic is relatively self-contained and includes links to TBPs and other documents, as appropriate. Some cross-linking between these tutorials is available.

Intermediary Level. Instruction on this level links the general concepts to more specific topics and details. Some links are added to the linear structure of the materials on the introductory level to support more experienced users but the guidance for less experienced users is retained. The topics covered are still self-contained, but cross-links to other relevant topics and documents are included.

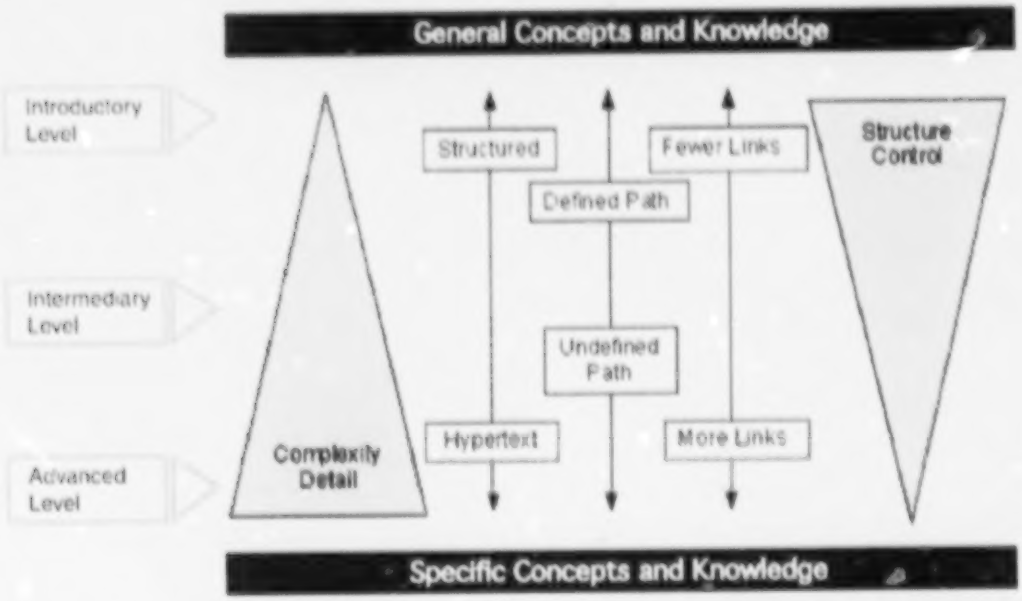

Figure 2. Sliding Scale Model for Web-Instruction for users of different levels of subject-matter expertise

Advanced Level. This instruction covers more specific topics and details. It is less structured and a hypertext in nature to accommodate the needs of experts and more experienced users. The topics covered are not self-contained, but rather cross-linked to other relevant topics and documents.

Instruction that is designed based on this approach aims to help users to perform a task in their work environment by allowing less experienced users to access the materials beginning with more general instruction, and more experienced users to access the more detailed information immediately.

Summary and Conclusions

The situation described in this case example represents a typical problem as it faces corporations and other institutions today: Highly complex information needs to be made accessible to a variety of users with different levels of expertise and different job functions. The solution described takes a systems approach and includes document management features, decision support, advanced searches, case examples, best practices and instruction. The design of the instruction is based on Situated Learning Theory (Lave, 1988) and on an extension to the Cognitive Flexibility Theory (Spiro & Jehng, 1990). Both theories emphasize the importance of the rooting of instruction in authentic situations, which in the case of the example described in this paper is the user's work environment. The authenticity of the environment is facilitated by providing case studies, examples and best practices. In addition, the examples given allow for the construction of rich schemata that

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can be used to construct a new schema when needed for a task at hand. The extension to Cognitive Flexibility Theory consists of three parts: the presentation of the instructional materials using different strategies and different media forms to represent knowledge, the growing data base of mini cases to which the learners add their newly constructed schemata, and the structuring of the instructional materials in different ways for different levels of learner's subject-matter expertise. On the more general level, which would be most interesting for less experienced users, more guidance and structure is given. On the more specific level, a less structured hypertext format is used to show the rich interconnectedness of the materials. This sliding scale of structure and control, as shown in Figure 2, aims to support different learners in one integrated system.

The instructional component of the OLISS system is designed to support the process of creating new knowledge, making it explicit, and translating it into different forms for effective dissemination across the organization. It provides the theoretical foundation for the rapid capture and dissemination of organizational learning that Raybould (1995) describes in the fifth phase of his Organizational Performance/Learning Model.

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Exploring the Power of Java 2 Platform, Enterprise Edition (J2EE) for Web-Based Enterprise Application Development

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Abstract: There is a rapidly growing demand for Web-based enterprise applications. For development of such applications, the specific needs of scalability, security, reliability, maintainability, extensibility, flexibility, manageability, portability, and platform-independence should be addressed. This is a major issue involved in development of Web-based enterprise applications. In this paper, we present a component-based approach to developing Web-based enterprise applications. We also explain how this approach addresses the major issue. Our approach makes use of component-based software development, 3-tier Web-based application architectures, and Java 2 Platform, Enterprise Edition (J2EE). We have adopted the new approach in several R&D projects. We provide an overview of one such project that was sponsored by IBM. In addition, we present lessons learned and future plans. We also provide the background information regarding the methods and technologies employed in this new approach.

Keywords: Component-based software development, Web-based enterprise applications, Java 2 Platform Enterprise Edition (J2EE), JavaBeans, Enterprise JavaBeans (EJB), Java Server Pages (JSP), Remote Method Invocation (RMI), Internet Inter-ORB Protocol (IIOP), Java Database Connectivity (JDBC), eXtensible Markup Language (XML)

1. Introduction

There is a rapidly growing demand for Web-based enterprise applications. For development of such applications, the specific needs of scalability, security, reliability, maintainability, extensibility, flexibility, manageability, portability, and platform-independence should be addressed. This is a major issue in development of Web-based enterprise applications. We present a component-based approach that addresses this issue. Our approach employs component-based software development, 3-tier Web-based application architectures, and Java 2 Platform, Enterprise Edition (J2EE), particularly, Enterprise JavaBeans (EJB), Java Server Pages (JSP), Java Naming and Directory Interface (JNDI), Java Database Connectivity (JDBC), Remote Method Invocation (RMI), and RMI Internet Inter-ORB Protocol (IIOP). We have adopted the new approach in several R&D projects including one sponsored by IBM.

The paper is organized as follows. Section 2 provides an overview of component-based software development approach. Section 3 describes a component-based approach to developing Web-based enterprise applications. Section 4 provides an overview of the key technologies adopted in the new approach. Section 5 describes how the approach was employed in an IBM-sponsored R&D project. Section 6 presents lessons learned and our future plan.

2. Component-Based Enterprise Software Development

Component-based software development (CBSD) is the rapidly emerging trend in industrial software engineering. CBSD delivers the promise of large-scale software reuse by allowing enterprise systems to be built by assembling reusable components rather than from scratch. CBSD is the natural evolution of distributed object technology [Pour 2000a]. CBSD is based on the concept of selecting a set of pre-engineered and pre-tested reusable software components, customizing the components, and assembling them within appropriate software architectures [Pour 1999a]. CBSD has the potential to: (1) Reduce significantly the time-to-market and development cost of enterprise systems by allowing systems to be built from reusable components, (2) Enhance the software reliability as components undergo evaluation during each use, (3) Improve the software maintainability and flexibility by allowing old components to be replaced by new high-quality components, and (4) Enhance the quality of enterprise systems by allowing application-domain experts to develop components and software engineers to assemble the components into systems [Pour 1999b].

3. Component-Based Development of Web-Based Enterprise Applications

Three major groups of components are identified in Web-based enterprise applications: (1) presentation, (2) application logic, and (3) data components [Pour 1999c, Penix 2000]. Presentation components operate in tier 1, application logic components in tier 2, and data components in tier 3. Figure 1 illustrates 3-Tier Web-based enterprise application architectures.

Presentation components manage the interaction between users and the software; processing users' requests for application services by calling application logic components in the middle tier. Application logic components manage the requests for access to the data components. A client may request connections to multiple heterogeneous servers including back-end servers, DBMS servers, and legacy applications. This is done through the use of the native interface of the relational databases (e.g. SQL). The middle tier resolves many infrastructure issues such as naming, location, security and authentication; allowing application developers to focus on the application development [Pour 1999c].

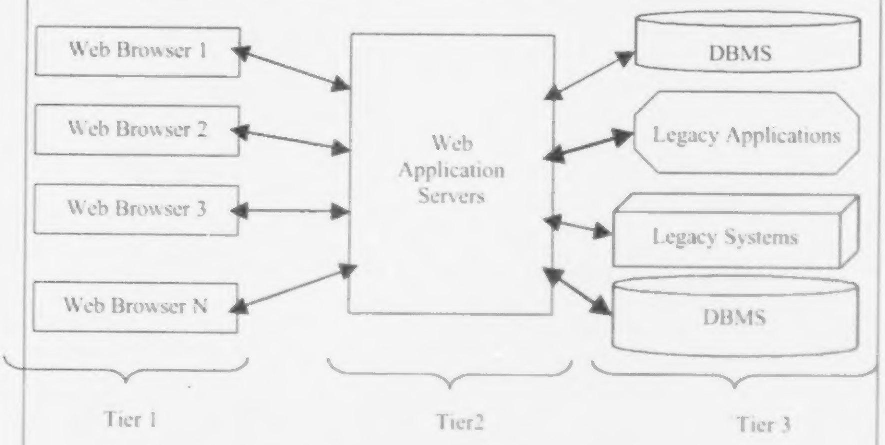

Figure 1. 3-Tier Web-Based Enterprise Application Architectures

3-tier Web-based application architectures have additional major benefits such as the followings: (1) System administrators can replicate application components and run them on different machines simultaneously. This will enhance the software availability, scalability, and performance; (2) Application logic components can share database connections. This will improve software performance by lowering the number of total sessions that a database server must support; (3) They provide access to other sources through native protocols & application interfaces rather than data gateways. This improves performance and allows users to control the data access; and (4) They allow developers to make the most of reusable application logic components, improving the software development and maintenance process [Pour 1999c].

4. Overview of Technologies Used in Our Component-Based Approach

In this section, we provide an overview of the technologies that we have integrated for component-based development of Web-based enterprise applications. Such technologies include J2EE and major Java-based technologies such as RMI, RMI IIOP, EJB, Java servlets, JSP, JNDI, and JDBC. The main reasons for selection of these technologies are also explained in this section.

4.1 Java 2 Platform, Enterprise Edition (J2EE)

Java 2 Platform, Enterprise Edition (J2EE) from Sun Microsystems Incorporated supports the foundation for networking, the Web, and database connectivity for Web-based enterprise application development. J2EE provides a platform-independent, portable, secure, and standard enterprise-class platform for server-side deployment written in the Java language--Enterprise JavaBeans (EJB). J2EE provides a robust suite of middleware services required for 3-tier Web-based enterprise application development. For example, Enterprise JavaBeans--Java-based component server model--is the cornerstone of J2EE [Asbury 1999]. J2EE includes other Java-based technologies including Java servlets, Java Server Pages (JSP), Java Database Connectivity (JDBC), Java Remote Method Invocation (RMI), and RMI IIOP. Several of those technologies including JSP depend upon eXtensible Markup Language (XML).

4.2 Java Remote Method Invocation (RMI) and RMI IIOP

Java Remote Method Invocation (RMI) extends object-oriented programming techniques to networks. RMI supports automatic activation of remote objects, dynamic class downloading, and distributed garbage collection [Govani 1999]. Java RMI enhances basic Remote Procedure Call (RPC) functions by allowing servers to export objects including their implementation from their local Java Virtual Machine (JVM), and allows clients to make method calls on those exported objects across a network. With code downloading feature, RMI allows subtypes to be passed during these method calls without requiring clients to have a prior knowledge of the actual type. RMI IIOP is a portable extension of RMI that can use the CORBA Internet Inter-ORB Protocol (IIOP). CORBA IIOP is a robust platform- and language-independent protocol.

4.3 Enterprise JavaBeans (EJB)

Enterprise JavaBeans (EJB), designed by a consortium of companies led by Sun Microsystems Incorporated, is a Java-based component model for the development and deployment of reusable platform and application-independent sever-side components. EJB components can be used in application servers, transaction servers, and database servers. Enterprise beans can be assembled with Java beans to create new Web-based enterprise applications.

EJB inherits all Java's attractive features including portability, platform-independence, security, reliability, maintainability, flexibility, and extensibility. EJB is indeed the only server-side component model that is cross-platform. That is why EJB is the best choice for building server-side components of Web-based enterprise applications, as such applications should run in distributed and heterogeneous computing environments [Pour 1999a, 2000a].

EJB has additional advantages for Web-based enterprise application development. EJB provides efficient data access across heterogeneous servers; faster Java client connections, transaction state management, caching, and queuing; connection multiplexing; and transaction load balancing across servers [Pour 1999a]. Components built using EJB gain middleware services (i.e. transactions, persistence, security, state management, component lifecycle, threading, etc.) implicitly and transparently from the EJB server.

Application development with EJB does not involve transactional and security semantics because the transaction and security rules for an enterprise bean can be defined at assembly and deployment phases. For instance, the transaction semantics are defined declaratively through a bean's deployment descriptor rather than programmatically. The EJB server uses a transaction attribute specified in the EJB deployment descriptor to manage the start, commit, and rollback of transactions, on the behalf of its enterprise beans. Therefore, application development using EJB does not involve low-level system programming such as thread-aware programming. As a result, developers of EJB applications can focus on the software quality improvement rather than low-level system programming [Pour 2000a].

EJB uses Java Naming and Directory Interface (JNDI) for locating objects across an enterprise [Vogel 1999]. RMI and RMI IIOP are used for making client-side calls to EJB objects; thus eliminating the need for complex server-side programming [Valesky 1999].

4.4 EJB versus MTS and CORBA Components

EJB and Microsoft Transaction Server (MTS) are both designed for developing server-side components. They both provide support for component-oriented transactions, declarative authorization, resource pooling, state management, and some other related services. EJB is language-dependent while the OMG CORBA Components (currently under development) is not. Since all platforms are equipped with JVM, language dependency of EJB does not raise any issue. Furthermore, EJB offers a series of attractive features including the followings:

- EJB is portable. The EJB transaction server concept allows scalability, reliability, load balancing, and atomic transactions of enterprise applications on various platforms. However, MTS is Windows-platform-dependent. The OMG CORBA Components (currently under development) is portable.
- EJB inherits attractive features of Java. As a result, EJB leads MTS in addressing security issues that need to be resolved in development of Web-based enterprise application.
- Application development using EJB does not involve creating and using Interface Definition Language (IDL) files. Both MTS and CORBA Components require IDL programming for application development. Consequently, it is easier to develop, modify, and maintain applications using EJB and JavaBeans than using CORBA, MTS, or other COM-based technologies.

4.5 Java Servlets

Java servlets are networked components that allow extension of the functionality to a Web server. Servlets are different from EJB components, as they do not provide the complete set of the EJB server-side component features. Unlike EJB, Java servlets are not tied to the Web application servers in tier 2. Servlets extend Java-enabled servers, and combine Java strengths on the server as a portable, platform-independent, and network-centric language with the accessibility of HTML clients to deliver database applications that are accessible to any client running a browser. Servlets are Java components that service HTTP requests and dynamically generate HTML. This makes servlets suitable for performing some Web tasks that require generic request/response-oriented components, with no management of application servers. Servlets take the requests of clients (Web browsers) in tier 1 and issue a response back to the clients after the requests are processed.

4.6 Java Server Pages (JSP)

Java Server Pages (JSP) are an integral part of the Java Platform for Enterprise. JSP create dynamic Web pages using Java as a scripting language. JSP are primarily used in situations in which a Web page changes with every new request of the client. The JSP access JavaBeans, take the data values from the beans, and display the data on the Web page for the client's viewing.

JSP emphasize components. JSP are entirely platform independent, both in dynamic Web pages and underlying server components. JSP provide a way to combine the worlds of HTML and Java servlet programming. The HTML is enhanced with new tags that specify the programming of a servlet to control the generation of dynamic content.

CGI is not suitable for Web-based enterprise applications due to its scalability issue. Each new CGI request launches a new process on the server. When multiple users try to access the program concurrently, the processes consume all the resources available to the Web server. This degrades the performance of CGI-based applications significantly.

4.7 Java Naming and Directory Interface (JNDI)

The Java Naming and Directory Interface (JNDI) is a standard Java naming and directory services. JNDI provides a standard interface for locating users, machines, networks, objects, and services in distributed and heterogeneous computing environment. With JNDI, a single API can be used to access different directories and different protocols. JNDI is used by RMI, EJB, JDBC, etc.

4.8 Java Database Connectivity (JDBC)

Java Database Connectivity (JDBC) 2.0 package is a standard Java extension for providing Java programs and Java components with the access to the data stored in relational databases. JDBC inherits portability and platform-independence features of Java. JDBC is the Java wrapper for SQL. It eliminates the need for a gateway program, as it handles connectivity to relational databases, fetching query results, committing or rolling back transactions, and converting SQL types to and from Java program variables. JDBC consists JDBC API and JDBC manager driver API. The JDBC API sends various SQL statements to JDBC manager driver API. The JDBC manager driver communicates with various third parties' drivers that are connected to the database, and returns the result of query to the user, or performs the action specified by the query [Pour 1999c].

5. Our R&D Project

We have adopted the new approach for component-based development of various Web-based enterprise applications. One such application was built in an R&D project sponsored by IBM. We developed a prototype of a 3-tier Web-based application for course registration. The system allows students to register, add, drop, withdraw, and inquire a variety of information regarding courses, schedule, and the status of their registration, billing, etc. The system can be customized easily for the use of any large company university or educational institution.

The new component-based approach addresses specific needs of scalability, security, reliability, maintainability, extensibility, flexibility, manageability, portability, and platform-independence. Student participation in the project was in the coding and testing phases. The project results are being used in our on-going research project.

5.1 Web-Based Enterprise Application Architecture

Figure 2 illustrates the architecture of 3-tier Web-based enterprise application developed in this project.

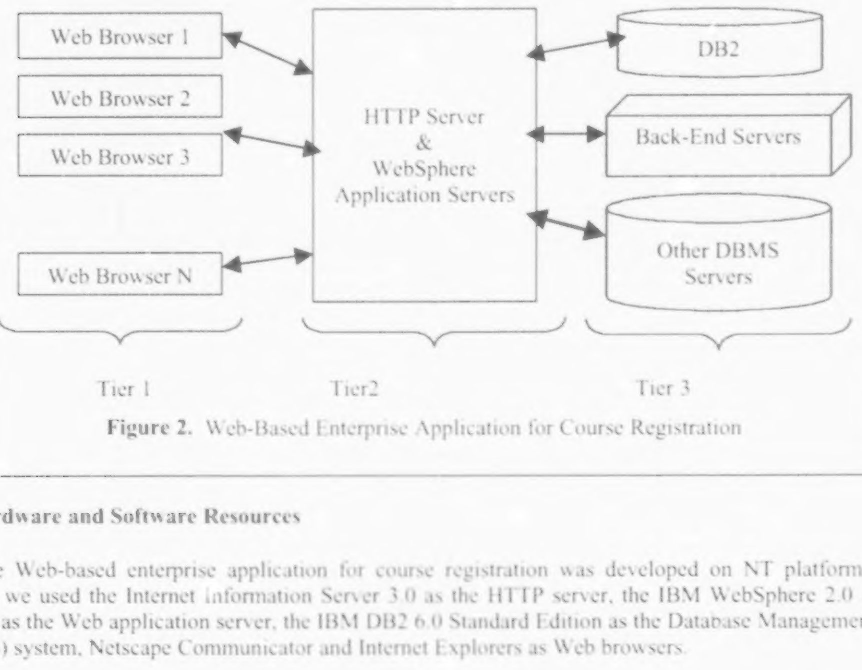

Figure 2. Web-Based Enterprise Application for Course Registration

5.2 Hardware and Software Resources

The Web-based enterprise application for course registration was developed on NT platform. In this project, we used the Internet Information Server 3.0 as the HTTP server, the IBM WebSphere 2.0 Advance Edition as the Web application server, the IBM DB2 6.0 Standard Edition as the Database Management Server (DBMS) system, Netscape Communicator and Internet Explorers as Web browsers.

5.3 Implementation

We have used EJB to build application logic components (tier 2) of the 3-tier Web-based enterprise application for course registration. Clients (e.g. Web browsers) make HTTP requests to view the desired Web pages. When a client presses the "Submit" button, a servlet is called. The Java servlets are used to service HTTP requests and to generate dynamically HTML files. The XML files ".servlet" are used to configure servlets. The servlet calls an enterprise bean (tier 2) in charge of performing a specific task. A bean's task may include database lookup, a transaction, etc. After the bean completes its task, the servlet decides which Web page should be displayed, and calls a JSP accordingly.

JSP are used for displaying dynamic Web pages. The Java Server Pages access the beans, takes data values from the beans, and creates a dynamic Web page for the client. JSP technology allows embedding Java code in Web pages. JSP make it possible to create dynamic personalized Web pages. The scripted HTML file has a ".jsp" extension. When a Java Sever Page is encountered, the application server parses the page and creates a servlet. The servlet is then compiled and its service() method is invoked. Parsing, generating code, and compiling are only performed once (unless the ".jsp" file changes). All JSP components can be dynamically upgraded or updated without interrupting the application operation. Web application server will automatically detect the new JSP if any, and load the new JSP into the memory when the client's browser visits the page. The implementation details can be found in [Tee 1999].

5.4 Evaluation

Industry representatives and several faculty members (including the author) with industrial experience have evaluated the results of the R&D project. The 3-tier Web-based application developed using the new approach has met both the project functional and non-functional requirements.

6. Lessons Learned and Future Plans

We have presented a component-based approach to developing 3-tier Web-based enterprise applications. To address the specific needs of reliability, scalability, maintainability, flexibility, portability, platform-independence, security, performance, extensibility, the new approach makes use of component-based software development, 3-tier Web-based enterprise application architectures, and J2EE, particularly, EJB, JSP, RMI, RMI IIOP, JNDI, and JDBC. We have adopted this approach to build a variety of Web-based enterprise applications including a Web-based enterprise application for course registration at the enterprise level. We plan to enhance the application by upgrading graphical user interface with dynamic swing components; adding more functionality such as discount, electronic notification of new course offering, etc.; allowing users to change their contact information; enhancing administrative functions such as sending electronic notification to appropriate officials.

Students involved in such R&D projects have gained valuable experience by exploring the power of J2EE and adopting the new component-based approach to developing Web-based enterprise applications. It would help significantly if students gain experience with J2EE and the Java-based technologies in a few smaller projects before they work on similar projects. The results of the project are being used in our on-going CBSD research. Industry has been supportive of such graduate research projects. The author plans to continue supervising similar projects, as our experience shows that such R&D projects in the university provides students with a great educational opportunity.

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A Method of Labelling Hypertext Links in a Context - Dependent Way

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Abstract: Link typing is a way to help user navigation in the hypertext space because it gives to the user an idea of the information that is "under" the link. Former link labelling methods have been focused on the relationship between the kind of information linked and not on the information contained in the linked nodes of the hypertext. In this paper a new point of view is suggested: following a link the user is moving in the hypertext space, so the link label has to highlight the direction of this movement in order to suggest to the user if s/he is moving towards the information needed or is going away from it. The proposed method can be applied to developed hypertext.

Introduction

Links in a hypertext are not only the mechanism to browse the information in the hypertext information space but they also represent a structure in this space because they create relationships between the nodes and, as said in (Carmel et al., 92): *"Links are supposed to present relations that help the browser to integrate, synthesize, and associate nodes in the domain."* Links can have some standard meaning, for example referential links, glossary links and so on. Other meanings change from one type of hypertext to another: for example in hypertext generated by collaborative work systems or problem exploration systems links serve to glue pieces of the discussion together; in authored hypertexts links are used to associate related information and usually the author choose the link source that readly reveals the kind of information "under" the link; in automatic hypertext, as the search results of a search engine, links come from clusters of similar information in information space (Allan, 95). In this case there is no effort to indicate the kind of information linked and why it is linked.

The "Invisible" Information

The "invisible" information carried by links enables the reader to understand the relative position of the information in the information space. Problems arise when the hypertext structure is different from the user's mental model and consequently not understood by the user (Carmel et al., 92); if this happens the user will soon be "lost in the hyperspace"(Halasz 88). This is particularly important in automatically generated hypertexts such as search engines results because these hypertexts are poorly (or not at all) structured and submitted to a user who has precise information needs. In this paper a link labelling method that will help the user moving inside the information space is presented.

Link Labelling Techniques

Many link taxonomies have been proposed in the past; in (Nielsen 92) links are basically split into two categories: explicit links that are defined by somebody and explicitly shown to the user and implicit links that follow from various properties of the information such as glossary links. In (Trigg 83) links are separated into more than seventy categories such as abstraction, example, simplification, etc. In (Ginige et al. 92) links are classified into structural links that define the logical structure of the hypertext documents, referential links that could be automatically generated by glossary systems and associative links due to association of ideas that is the basic concept of hypertexts. In this classification structural links are easy to understand and where present are useful tools to avoid the "lost in the hyperspace" feeling, but, as referential links, they carry little information about the structure of the information space, so that they are sometimes of little use for the user that has a precise information goal.

In (Allan, 96) Allan proposes another link taxonomy where the main categories recognized are: pattern matching links, manual links and automatic links. The first category groups together links generated by using pattern-matching techniques; this category contains the referential links mentioned before and links due to the matching of long text sentences, as well as structural links and links that tie a figure to its reference. Manual links are difficult to generate by using computer algorithm techniques, these includes links related to free association, the thinking mechanism that hypertexts tries to emulate; these kinds of links can be generated automatically only in restricted domains and they depend on the context. Automatic links are extensively described in (Allan, 96) and can be divided in many subcategories such as revision, summary, expansion, aggregate, and equivalence. These links could be automatically generated by natural language processing techniques. The kinds of links identified by Allan are related to the relationship between the nodes as the link labels suggest (revision, expansion, equivalence), the attention is focused on the relationship between the "kind" of information "under" the link and the "kind" of the information currently shown.

In the link labelling methods described above the attention is devoted to letting the user know which type of information is linked to the visualized node but no information is provided about the direction of the movement in the information space following the link. If the user is browsing the hypertext with a specific goal this movement needs to be towards the right information. So the link label should show the user the direction of the movement. For this purpose it is helpful to divide the hyperspace in meaningful regions using clustering techniques and to label these regions according to the information contained.

Document Representation Techniques

A link structure that establishes an order in the document space comes from a kind of metrics, suggested by the author's experience or knowledge (or calculated in some way), that allows the hypertext author (or a clustering algorithm) to compare the documents and decide which ones are semantically near each other and can be linked together. According to what is reported in (Rijsbergen 79) "the frequency data can be used to extract words and sentences to represent all the documents", and consequently used to build a set of features, often referred to as "code words" or "keywords", capable of representing all the documents in the document space. Using this set of features a document can be represented by a string of 1 and 0 whether each feature is present or not in the document (such as in the "Boolean model" of information retrieval (Gudivada et al. 97)). Moreover it is possible to give a weight to the feature in the document as in the Vector Space Model of information retrieval (Gudivada et al. 97); so that a document is represented by a vector in a vector space.

Vector Space Representation

The vector space representation of documents allows us to associate a vector to a document in a multi dimensional space (the representation space). In this vector space each piece of text is a vector (a point) and the axes of this space represent the keywords (or the sentences) chosen to represent the documents and the queries. If the vocabulary is well chosen (i.e. the code words are significant) the direction of the base vectors represents the main concepts used to represent the set of documents. To obtain the representing vector of each piece of text it is possible to use different formulas based on the statistics of the words in the text (Rijsbergen 79):

- If the non-normalized representation is used the vectors can have different lengths depending on the number of words in the text. It is possible to use the Euclidean metrics to measure the distance between texts but the length of the vectors affects this distance measurement.
- If the normalized representation is used vectors have the same length and are on the surface of a hypersphere centered on the origin of the axis system. In this case the cosine method can be used to measure the distance between the different vectors.

The vector representations of the text can be clustered by using many techniques, and these clusters can be labelled. Consequently the space can be divided in regions that could facilitate the navigation of the users (Botafogo, 93).

The Proposed Link Labelling Method

As said before a link connection between two text nodes is a connection between two document representations and indicates a possible movement in the document set. The purpose of the link labelling method proposed is to label this link in a way that represents the direction of the movement in the document set. This can be basically done by observing the difference between the two sets of features and highlighting the most important differences; a more useful help is given if the document set is divided in meaningful labelled regions, by using clustering techniques on the document representations or using the information contained in the link structure of a developed hypertext as described in (Botafogo, 93) and (Roussinov & Ramsey 98).

Suppose that d_1 and d_2 are two documents and, for the sake of simplicity, that only two keywords *a* and *b* are used to represent them. If the normalized representation is chosen the two documents will be represented as in fig. 1

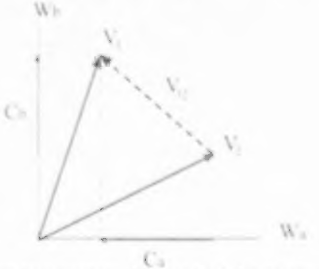

Figure 1: The difference between two vectors. Notice that the arrows represent the vectors not links

where $\mathbf{v}_1$ and $\mathbf{v}_2$ are the vector representation of d_1 and d_2
If the user follows the link from d_2 to d_1 s/he will follow the path from $\mathbf{v}_2$ to $\mathbf{v}_1$ that is presented by the vector $\mathbf{v}_{12}$ in fig. 1. This vector can be obtained as the difference between $\mathbf{v}_1$ and $\mathbf{v}_2$

$$\mathbf{v}_{12}=\mathbf{v}_1-\mathbf{v}_2$$

The two components of this difference vector are c_a and c_b and can be obtained as:

$$c_a = v_{1a} - v_{2a}$$
$$c_b = v_{1b} - v_{2b} \tag{1}$$

This means that the weight of the keyword a will diminish from d1 to d2 and the weight of the keyword b will increase. This will give important information about the contents that the user will find in document d2 compared to document d1 and a label reporting this difference will give information that is dependent on the context of the anchor document.

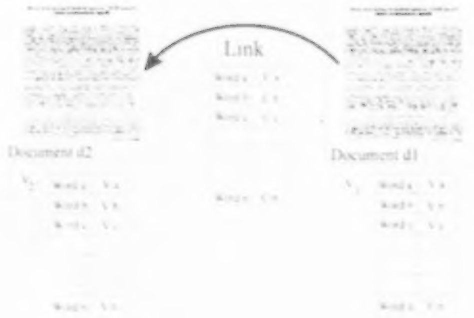

Figure 2: A representation of the link label

In practice the link will be labelled by using a subset of the same keywords used to represent the document in the vector representation method. The importance of the keywords (that can grow or diminish if the user is moving from document d_1 to document d_2) will be highlighted by the components $c_a, c_b, \ldots, c_n$, calculated by using the fomulas in (1). This will enable the user to predict the topic of the document which s/he can reach following the link, compared to the document that s/he is currently reading. In this sense this label is dependent on the context of the document shown. Moreover the ranking of the keywords could be obtained using their value from the formulas (1) or by a set of weights chosen by the user at the beginning of the navigation session.

It is also possible to obtain information on the direction of the navigation on a large scale if the hypertext space is divided in meaningful regions by informing the user which region he will move to by following a particular link.

Suppose that the documents are grouped in a set of clusters C and focus our attention on a cluster C_1 of k documents. The k vectors that represent the documents in C_1 define a subspace S in the hypertext space of dimension s<=k. If a user is navigating inside the documents of the subspace S the links could be labeled using the method described above, but if the user follows a link that points to a document outside the cluster, for example represented by a vector v, it is possible to advise the user and to give him information about the difference between the topic common to the documents in the cluster and the documents outside it. In fact, given the vector v it is possible to find a unique decomposition :

$$\mathbf{v}=\mathbf{v}_{\perp}+\mathbf{v}_{s} \tag{2}$$

where $\mathbf{v}_s$ is a vector that belongs to S and $\mathbf{v}_{\perp}$ is the one orthogonal to S. This can be done by using the Gram-Schmidt orthogonalization process that is reported in Appendix A. The orthogonal component $\mathbf{v}_{\perp}$ carries the information about the main difference between the documents of the cluster and the document indicated by the link. A three-dimensional representation is given in figure 3, where the space spanned by all the documents is supposed to be three-dimensional and the subspace S spanned by the documents in the cluster C_1 is supposed to be two-dimensional.

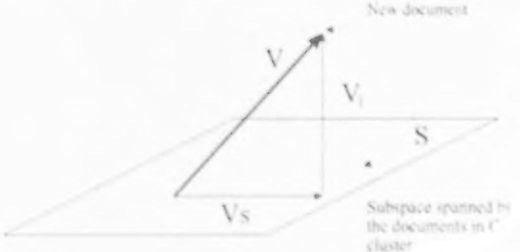

Figure 3: The projection of a vector on a subspace. Notice that the arrows represent the vectors not links

Conclusions and Future Work

The link labelling method presented enables the user to obtain information about the topic of the target document. This information could be automatically calculated for existing hypertext and for hypertext systems under development, and it is available as a paired keyword-keyword weight that indicates the growing or diminishing weight of the keyword in the target document; the author is currently working on a graphical interface system that will allow the user to easily grasp this information. Moreover the author is working to extend this method to the Boolean document representation that is simpler and faster to calculate than the Vector Space Representation used.

Appendix A

To find the dimension of the subspace S and a basis of this subspace it is possible to follow the Gram-Schmidt orthogonalization process. Consider the k vector that are in the cluster C_1:

$$\mathbf{e}_1, \mathbf{e}_2, \mathbf{e}_3, \ldots, \mathbf{e}_k$$

Choose the first direction e1 of the new basis. The second vector can be found as

$$\mathbf{h}_2 = \mathbf{v}_2 - \frac{(\mathbf{v}_2, \mathbf{h}_1)}{\|\mathbf{h}_1\|^2}\mathbf{h}_1 \tag{3}$$

$$\mathbf{h}_1 = \mathbf{e}_1$$

where $(\mathbf{v}_2, \mathbf{h}_1)$ is the inner product of the vectors $\mathbf{v}_2$ and $\mathbf{h}_1$, and $\mathbf{h}_2$ is orthogonal to $\mathbf{h}_1$. The other vectors can be find using the formula:

$$\mathbf{h}_i = \mathbf{v}_i - \sum_{j=1}^{i-1} \frac{(\mathbf{v}_i, \mathbf{h}_j)}{\|\mathbf{h}_j\|^2}\mathbf{h}_j \tag{4}$$

Using the same formula it is possible to find the decomposition of the vector $\mathbf{v}$ in $\mathbf{v}_\parallel$ and $\mathbf{v}_\perp$ mentioned in (2): if $\mathbf{h}_1, \mathbf{h}_2, \ldots, \mathbf{h}_k$ is the basis of the subspace S calculated by using the formula (3), and the components $\mathbf{v}_\parallel$ and $\mathbf{v}_\perp$ can be found as:

$$\mathbf{v}_\parallel = \mathbf{v} - \sum_{j=1}^{k} \frac{(\mathbf{v}, \mathbf{h}_j)}{\|\mathbf{h}_j\|^2}\mathbf{h}_j \tag{5}$$

$$\mathbf{v}_\perp = \mathbf{v} - \mathbf{v}_\parallel$$

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Browsing a Document Collection as an Hypertext

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Abstract: An important consequence of the diffusion of the Web is that end users are more and more getting used to browsing information according to the hypertext linking mechanism. As a consequence, not only will the number of hypertext structures increase in the near future, but also the demand of hypertext access to existing non-hypertextual sets of documents will become more and more pressing. However it is difficult to develop hypertext structures starting from an existing document collection. In this paper the authors analyze the problem of developing a link structure from a document set and show some recently proposed solutions based on artificial neural networks.

Introduction

The large diffusion of World Wide Web has carried the hypertext in evidence to the audience and nowadays it is impossible to conceive an information repository that is not accessible on the Web. Two of the main consequences of the explosion of the Web are that more and more hypertext structures will be built up and that the hypertext browsing will become the most common way to access information, even for already existing sets of documents. Structuring an existing large set of documents according to the hypertext paradigm is a really complex work: firstly, it is necessary to extrapolate the information nodes from the whole documentation; afterwards, these nodes must be analyzed one by one in order to identify the associative links among them; finally, the links between the different parts of the documents can be set up. Therefore, hypertext developers should be supported by automatic or semi-automatic tools to handle large sets of documents in an effective way.

In this paper, after a short gallery of the available tools based on neural networks, the authors present Hy.Doc. a system that automatically provides hypertext access to large sets of documents.

Hypertext – Like Access to Information Space

The set of nodes in a hypertext system can be considered as a set of points spread over an information space and the links as relationships between them. A common assumption is that two nodes are linked together if they are semantically related in some way. Although this is not always true (e.g. it is not true for hierarchical structures that allows the user to reach more nodes starting from an index node), we focus our attention on the links between semantically related nodes. Automatic hypertext construction methods are often based on the assumption that the semantic of a short text (such as a hypertext node) is modeled by a function of its vector representation, obtained, for example, by using the vector space model (Salton et al. 94). If all the hypertext nodes are transformed into vectors by using the vector representation, the set of points in the information space are mapped into a set of points in an n-dimension vector space. The fundamental hypothesis is that if two chunks of information are semantically related (for example they are about the same topic) the related representation points in the vector space will be close to each other. By accepting this hypothesis, automatic hypertext construction methods group these representation points in clusters, which become central to the individuation of the links. Even if these structures are different from the ones that could be developed by an hypertext author, yet they can be useful to support hypertext developing and can guarantee a hypertext-like access to the information space.

Self Organizing Map Applications to Information Space Browsing

The Self-Organizing Feature Map (SOM) (Kohonen 95) is a neural network, proposed by Kohonen, that during the learning stage tries to build a representation of some features of input vectors. This behavior is typical of some areas of the brain where the placement of neurons is sorted and it often reflects some features of sensorial inputs. In the SOM, neurons are organized in a lattice, usually one or two-dimensional array, that is placed in the input space and is spanned over the input vectors distribution. During the learning stage the neural network creates a cluster of the input vectors. The SOM algorithm operates a classification where the distance between neurons represents the distance between two clusters of vectors in the input space. Using a two dimensional SOM network it is possible to obtain a map of the input space where closeness between units in the map represents closeness of clusters of input vectors.

In (Rizzo et al. 99), the authors have presented a system, based on a Self Organizing Map, that supports hypertext authors in identifying the potential links between information chunks. In particular, the SOM network organizes information nodes into clusters and spreads them over a map according to the "semantic distance" between the information nodes.

As said before links in a hypertext represent a semantic structure on the information space and these conceptual associations can be seen as neighborhood relationship on the map; if an information map is created by using nodes of an existing hypertext, it is possible to assume that the information map will reflect in some way this semantic order. In other words, it is possible to think that linked information in existing hypertexts will be on the same place or near each other in the information map, and it is therefore possible to compare the link structure built by the developer to the node organization imposed by the neural network.

We have proved that the distribution of links in a hypertext is significantly approximated by the "semantic distances" calculated by a SOM network. The obtained information map is converted in the HTML page shown in fig 1, to assist document navigation.

Figure 1: A fragment of the information map HTML page

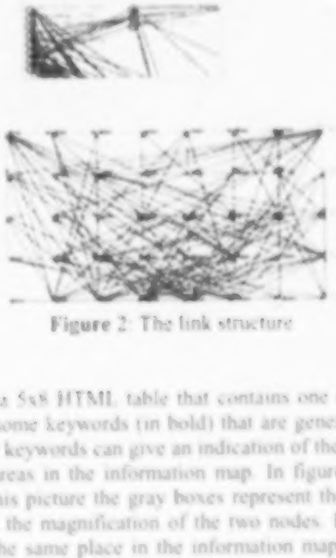

Figure 2: The link structure

In figure 1 each neural unit is represented as a box in a 5x8 HTML table that contains one or more hypertext nodes that are semantically related to each other, and some keywords (in bold) that are generated by taking the six larger vector components of each neural unit. These keywords can give an indication of the kind of documents contained in each box and can help to label some areas in the information map. In figure 2 it is possible to see the link structure over the information map. In this picture the gray boxes represent the neural units and contain the hypertext nodes, as it is possible to see in the magnification of the two nodes. If linked information atoms on hypertext are on the same, or nearly on the same place in the information map then in figure 2 there will be few links between distant nodes or not at all. Despite to the appearance of fig. 2, it has been found that 80 links are between nodes that are on the same place in the information map (the same neural unit), and 151 links are between nodes near each other, so 231 links (64.7 % of the total link number) are between information atoms near each other in the information map. A major limit of this approach is that the information map cannot reproduce a hierarchical structure, which is common in hypertext, so that index node can generate links that span the whole information map, in the chosen hypertext, almost 10 % of the links are due to hierarchical structures.

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An Hypertext-Like Access to a Document Collection

The previous exposed applications allows an hypertext author to browse the information space (as defined before) using the map built by the SOM network. Note that in (Rizzo et al. 99), the map has been generated starting from information chunks. The same approach can be generalized to get to a hypertext-like organization of sets of documents. In (Kaski et al. 96), (Merkel 98), (Rauber 98) and (Roussinov & Ramsey 98), an SOM network has been used to produce, starting from a set of documents, an ordered document map where a user can navigate and find the right document using explorative search. The developed document map has almost the same appearance than the information map shown in Fig. 1; however, whole documents instead of single information atoms are clustered. However, in order to identify hypertext links starting from a collection of documents (like scientific papers or technical reports), a further step is necessary. In fact, documents are not information atoms, they do not carry a unique idea or concept, they have an introductory part, they have to explain the fundamental ideas and describe the new ones and finally they have a conclusion. In short, they are composed of many information chunks, and it is necessary to break down each document into information atoms.

It is really difficult to separate information atoms such as defined in (Ginige et al. 95) starting from a complex document as a scientific paper. For our purposes it has been assumed that paragraphs express a quantity of information that it is difficult to broke any further, in automatically way, without loosing the original meaning. Therefore, paragraphs have been considered as the information atoms of a hypertext.

In our system links are generated between the paragraphs of the documents; classification of paragraphs is expected to be much more precise than classification of the whole documents. For these reasons, the generated link structure is more coherent and meaningful than the one generated between whole documents. But it should be noted that, since a map of paragraphs can be misleading and difficult to be read for the end user, a map of documents is also developed and visualized in order to support browsing of the document set.

The Prototype of the system

The proposed system, called Hy.Doc. creates the link structure by a SOM neural network applied to the paragraphs (Fig. 3). However, since browsing between single paragraphs out of their context (the whole document) can be misleading, the links structure between paragraphs is transparent to the user: if the user is reading a specific paragraph, the Hy.Doc. provides him/her the links to all the documents containing paragraphs in the same cluster, rather than to the single paragraphs. For example, as shown in fig. 3, if the user is looking at an interesting idea described in paragraph 2 of document 1, the system will answer by proposing documents 2, 3 and 4 that contain one or more paragraphs related to the one the user is reading (paragraph 3 of document 2, par. 2 of document 3 and par. 2 of document 4).

The links generated by the system connect a paragraph to many documents. For this reason, the user needs a support to choose the document that is closer to his/her interests. To this aim a document map, like the one depicted in fig. 1, is developed. As told before the map groups document that are semantically related; the classification is more error prone for the reason explained before, but it can give some help. In this map the documents are organized in such a way that the ones about the same topic are on the same location on the map or in neighborhood locations. This map is represented as a HTML table, as shown in Fig. 1. Each cell on the map in characterized by a set of keywords to help the user understand the subject of the contained documents. The HTML table has been chosen as a visual representation of a bookshelf, that is an effective metaphor for this kind of organization.

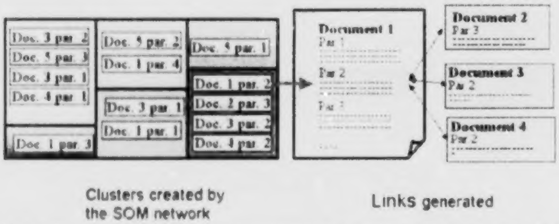

Figure 3: The links between document paragraphs generated by the SOM network

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A user can access the system through a common Internet browser. When a user gets access to the system, the document map is sent by the server and visualized in the user browser. S/He can locate the area of interest on the map, choose a document and visualize it by "pointing and clicking" on the map (when a document is visualized, only its location is shown on the map). Afterwards, the user can select a paragraph of interest from the document and ask the Hy.Doc. system for the other documents that contain paragraphs related to it, which are then visualized on the map (Fig. 4). The user can look at the topic areas of the returned documents and decide whether they are of interest for him/her or not; the abstract of the documents can be requested in order to support this decision.

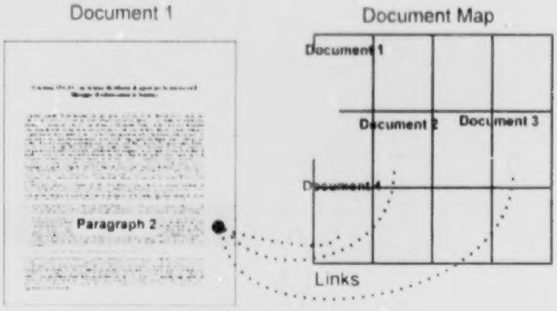

Figure 4: The Hy.Doc. system returns the related documents

Implementation Details

The Hy.Doc. system is based on a set of Java and JavaScript programs and a servlet running with an Apache web server; its first prototype has been used to organize the proceedings of the AACE WebNet 96 Conference that contains 201 scientific papers. These papers have been broken down into 1170 paragraphs by a Java program that tries to recognize the paragraph titles by analyzing the HTML tags. It should be noted that the HTML is a mark-up language and does not allow users to specify the structure of the documents; as a consequence, the beginning of each paragraph is not explicitly indicated, but it has to be identified starting from the document appearance. For example, in order to highlight the heading of a paragraph, the author could use the <B> tag (with a couple of <P> tags to add blank lines) rather than using the <H> tags. Consequently, the paragraph separation is not perfect, but these problems can be avoided by using a fixed document template or by including structural information in the documents, as when using XML.

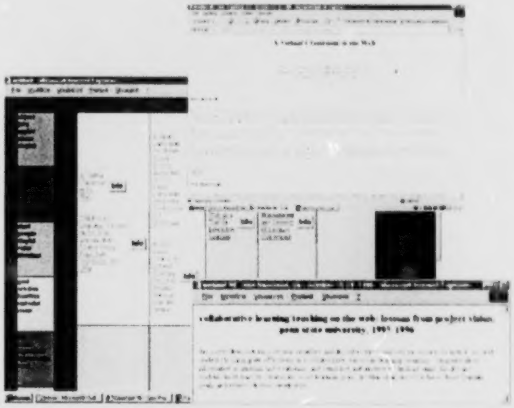

Figure 5: A screenshot of the prototype

The representation of the paragraphs has been obtained through the TFIDF technique with a vocabulary of 150 words, so that the SOM2 neural network has been trained by using a set of 1170 vectors of 150 dimensions. Similarly, the same representation technique has been adopted to model the whole documents and the document map has been produced starting from the same vocabulary. A screenshot of the prototype is shown in fig. 5.

Conclusions

Empirical evidence shows that the approach is promising but needs some improvements. The hypertext like access provided by the prototype is an effective way to search information but it is still difficult for the user to have an overall idea of the document collection by inspecting the document map. So it is still difficult to have an idea of the topic of the paper highlighted by the system.

However it should be noticed that it is a non-trivial problem of information compression to carry the overall idea of the topics of 200 or more documents through a small communication window such as the computer video screen (it is like looking a library through the key hole). Moreover the link structure built by the neural network is not perfect: the user could find that some documents linked together do not share the same topic or the same idea as expected. In the next issue of the system, the authors plan to use the user feedback to improve the link structure built by the network.

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CardioSurgery: An Environment to Support Surgical Planning and Follow-up in Cardiology

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Abstract: In a Medical School the education of future experts is carried out taking into account the theoretical aspects of the specialty and medical practice. For medical practice an important aspect of the training is the case discussion with experienced professors and physicians. This paper describes a support environment for Surgical Planning and Follow-up meetings, which represent an important part of the future cardiovascular surgeons training.

1. Introduction

The education of a cardiologist takes place in medical schools throughout formal classes, patients' care, discussions based on medical literature, clinical research based on patients' records and several meetings where medical students, residents, cardiologists and surgeons discuss patients' cases.

With the purpose of supporting these different aspects of Cardiology training, we have launched a project - CardioEducar – whose purpose is to develop a learning environment based on the Internet. CardioEducar, an educational meta-environment, offers an integrated environment through which professors, cardiologists, physicians and students have access to several educational environments. As a meta-environment CardioEducar comprises several working environments for cardiology teaching. The main focus is the construction of computer assisted learning environments based on the Internet for the cardiology domain, broken-down in two groups: learning environments to support the different meetings attended by physicians, cardiologists and students with teaching purpose, and (ii) Course Preparation Environment, through the factory of hypermedia intelligent tutor authorship for cardiology aimed at remote education (to be developed). Besides these environments CardioEducar will provide other resources related to tutors, educational software, databases and information in general for Cardiology teaching. One of the most important meeting deals with education and training in cardiovascular surgery. In our Medical School this education is done through two meetings: the Surgical Planning Conference and the Surgical Follow-up Conference. The goal of a Surgical Planning Conference is to determine the most suitable surgery for each patient. This goal is achieved through presentation and discussion of patients' clinical data by cardiologists, cardiovascular surgeons, residents and medical students. The aim of a Surgical Follow-up Conference is to discuss relevant facts of every surgery that took place during the previous week and how the patients responded to the procedure. Residents and medical students are encouraged to attend these two conferences and the cardiovascular surgeries, as part of their training.

The two conferences take place every week at the University Hospital and are ministered without technological support. As a consequence, the following problems were detected: (i) the cases are orally reported to the audience without any access to images of patients' exams (e.g. EKG echocardiogram and cineangiocardiography); (ii) patient data and the result of the discussion are usually lost after the conference since there is no organized way to record this information and to keep it for continual training and research, and, (iii) the lack of technological support makes it difficult for students to understand the surgical case and to follow the discussions.

This was the motivation for CardioSurgery, a hypermedia and internet based environment whose main goal is to support medical education on cardiovascular surgery. CardioSurgery will be adding to the first environment developed and integrated to the CardioEducar meta-environment - HyperClinic – whose objective is to support clinical case discussion meetings (Gama et al. 1997).

The support to medical education through specific tools has been proposed in different researches (Schewe et al. 1996), (Eliot & Woolf 1996), (Alexe & Gecsei 1996). Nevertheless, these experiments appear isolated and not as an integrated environment totally focused on this purpose, which constitutes the originality of our work.

In the following sections this environment will be described.

2. CardioSurgery

CardioSurgery is composed of four environments: the Authoring Environment, the Surgical Planning Conference Environment, the Surgical Follow-up Conference Environment and the Tutorial Environment (Fig. 1).

The Authoring Environment supports users in preparing the conferences. It offers facilities for introducing data of a surgical case into the system. These data include the patient' history, results and images of exams, definition of the planned surgery, information about the surgery and post-operatory data (Fig. 2).

The Surgical Planning Conference Environment offers technological support for the presentation and discussion of a patient's surgical case during the meeting. This environment supports meetings in which, from the presentation of patient data and from the ensuing discussion on the case, the most appropriate surgery is indicated. (Fig. 3 and 4)

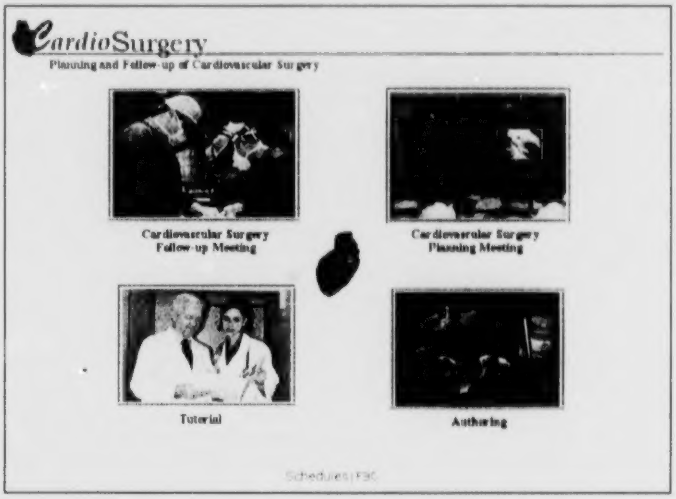
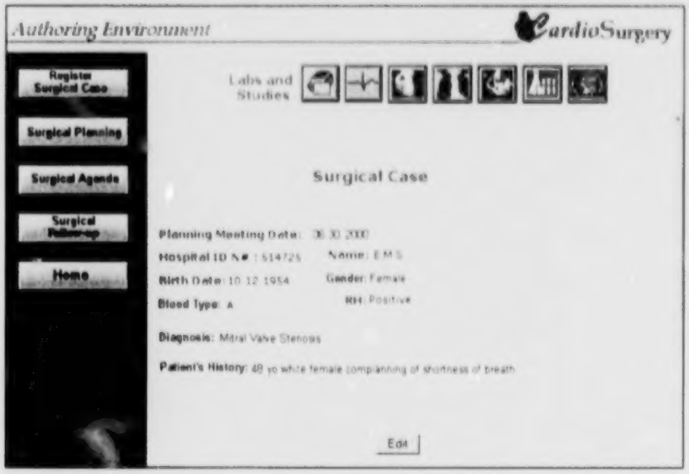

CardioSurgery
Planning and Follow-up of Cardiovascular Surgery
Cardiovascular Surgery Follow-up Meeting
Cardiovascular Surgery Planning Meeting
Tutorial
Authoring
Schedules | F3C

Figure 1: The homepage of CardioSurgery with the four environments


Authoring Environment
CardioSurgery
Register Surgical Case
Surgical Planning
Surgical Agenda
Surgical Follow-up
Home
Labs and Studies
Edit

Surgical Case

Planning Meeting Date: 30 30 2000

Hospital ID N#: 514725 **Name:** EMS

Birth Date: 10 12 1954 **Gender:** Female

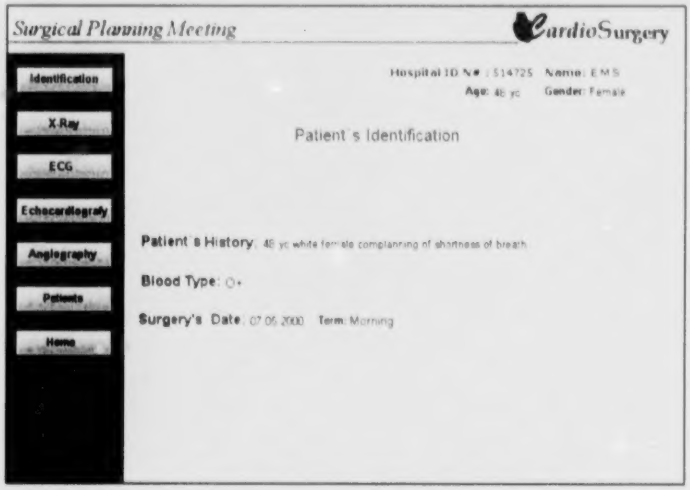
Blood Type: A **RH:** Positive

Diagnosis: Mitral Valve Stenosis

Patient's History: 48 yo white female complanning of shortness of breath

Figure 2: Authoring Environment: case recording

The Surgical Follow-up Conference Environment supports the presentation of the results of a surgery which includes images of its most relevant moments, patient's data during and immediately after the surgery and patient's evolution on the following days. The facilities offered by the Surgical Follow-up Environment enables images review and helps the learning of the surgical techniques in cardiovascular surgery, and post-operative follow-up by medical students.


Surgical Planning Meeting
CardioSurgery
Identification
X-Ray
ECG
Echocardiografy
Angiography
Patients
Home

Hospital ID N#: 514725 **Name:** EMS

Age: 48 yo **Gender:** Female

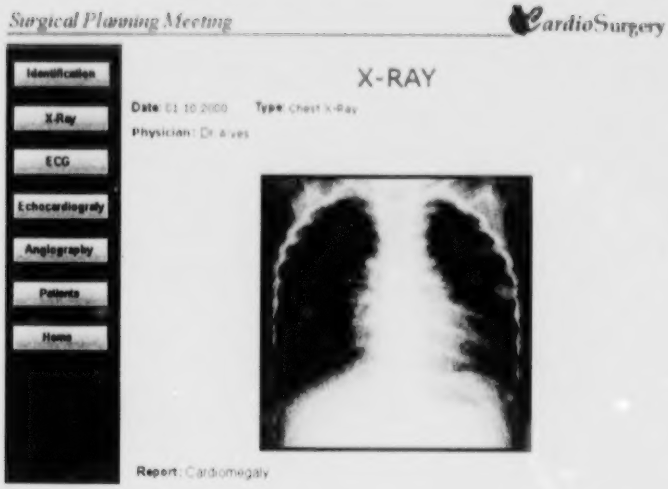
Patient´s Identification

Patient´s History: 48 yo white female complanning of shortness of breath

Blood Type: O+

Surgery's Date: 07 06 2000 **Term:** Morning

Figure 3: Surgical Planning Conference Environment: Patient Identification


Surgical Planning Meeting
CardioSurgery
Identification
X-Ray
ECG
Echocardiografy
Angiography
Patients
Home

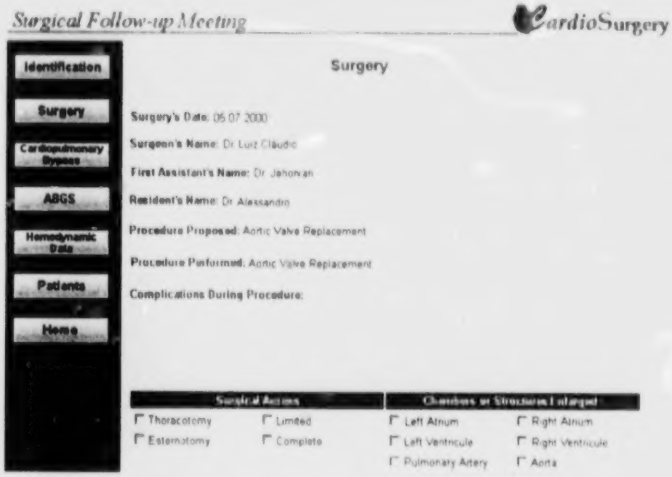
X-RAY

Date: 01 10 2000 **Type:** Chest X-Ray
Physician: Dr Alves

Report: Cardiomegaly

Figure 4: Surgical Planning Conference Environment: Chest X-Ray

Tutorial Environment organized in html pages supports medical students' education in the most important topics related to cardiovascular surgery (Fig. 6).


Surgical Follow-up Meeting
CardioSurgery
Identification
Surgery
Cardiopulmonary Bypass
ABGS
Hemodynamic Data
Patients
Home

Surgery

Surgery's Date: 05 07 2000
Surgeon's Name: Dr Luiz Claudio
First Assistant's Name: Dr Jehorvan
Resident's Name: Dr Alessandro
Procedure Proposed: Aortic Valve Replacement
Procedure Performed: Aortic Valve Replacement
Complications During Procedure:

Surgical Access		Chambers or Structures Enlarged	
☐ Thoracotomy	☐ Limited	☐ Left Atrium	☐ Right Atrium
☐ Esternotomy	☐ Complete	☐ Left Ventricule	☐ Right Ventricule
		☐ Pulmonary Artery	☐ Aorta

Figure 5: Surgical Follow-up Conference Environment: Operative Data

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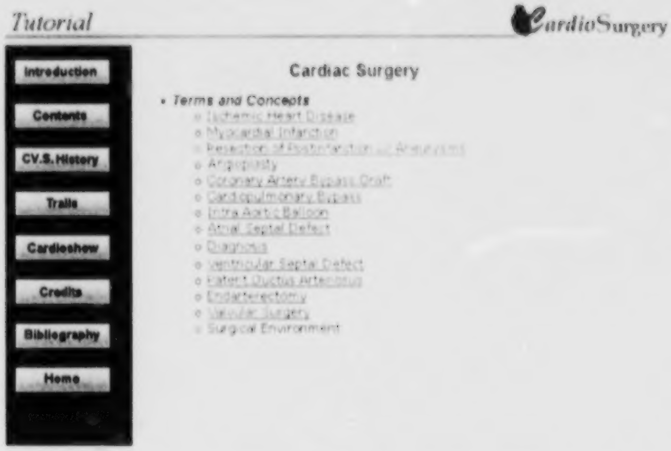

Cardiac Surgery

- *Terms and Concepts*
    - Ischemic Heart Disease
    - Myocardial Infarction
    - Resection of Postinfarction LV Aneurysms
    - Angioplasty
    - Coronary Artery Bypass Graft
    - Cardiopulmonary Bypass
    - Intra Aortic Balloon
    - Atrial Septal Defect
    - Diagnosis
    - Ventricular Septal Defect
    - Patent Ductus Arteriosus
    - Endarterectomy
    - Valvular Surgery
    - Surgical Environment

Figure 6: Tutorial Environment: Available Topics

3. Conclusion

CardioSurgery is being developed by a multidisciplinary team of cardiovascular surgeons and computer science specialists. A first prototype was built and after its evaluation by faculty members, surgeons and students we are now implementing the first operational version which will be in use in our University Hospital next May.

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GAMA,C. A., SOUZA, J. M., RABELO Jr., A. (1997). HyperClinic: Cooperative Hypermedia System for Medical Education. *Educational Multimedia and Hypermedia*, 1997, Calgary, CA.

SCHEWE, S.; QUAK, T.; REINHARDT, B. & PUPPE, F. (1996). Evaluation of a Knowledge-Based Tutorial Program in Rheumatology - A Part of a Mandatory Course in Internal Medicine. *Proc. of ITS'96. In Frasson, Gauthier, Lesgold (eds)*, Montreal, CA. 531-539.

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Models for User Access Patterns on the Web: Semantic Content versus Access History

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Abstract: This work focuses on clustering a site into groups of documents that are predictive of future user accesses. Two approaches have been developed and tested. The first approach uses semantic information inherent in the documents to facilitate the clustering process. User access history is then used to reorganize the clusters iteratively so as to better indicate access patterns. This method was found to not be an effective solution to the problem. Hence, a second method based on hierarchical clustering of trail information was developed. This method is shown to be far more effective than the first method.

1 Introduction

With the rapid proliferation of websites on the Internet over the past few years, it has become imperative for websites to enhance the quality of service that they provide in order to attract and sustain user traffic. The average user is interested only in a limited subset of the available content at a website. The emphasis therefore should be on developing tools that aid the user select that subset (automatic customization of hyperlink presentation order, for example). Such a strategy warrants predicting a user's actions based on past user-activity at the website.

One way to facilitate prediction would be to develop a model for user access patterns. The assumption is that patterns exist in aggregate user access histories that allow the behavior of one user to be predicted based on the behavior of previous users. The first step towards modeling user access patterns is modeling the site. Site modeling involves organizing and grouping the pages (or documents) present in the site. A variety of criterion can be used, atleast in theory, to group the documents available on the web server. These criterion can be placed under two broad categories: (a) organization based on the content of documents ([Green, 1998, Weiss et al., 1996, Fowler et al., 1996]) and (b) organization based on the access history of documents ([Joshi and Krishnapuram, 1998, Perkowitz and Etzioni, 1997, Mobasher et al., 1996]). In this paper we describe two approaches that we have developed to induce clustering of documents.

2 The World Cup 1998 Server Log Data

The test data for this research consists of 14 weeks of server logs from the 1998 World Cup Soccer site (http://www.france98.org). The data was collected during the period of the 1998 World Cup games. The server logs (the user access history for 14 weeks) were provided by Hewlett-Packard Labs ([Arlitt and Jin, 1999]). The following table lists some basic statistics about this data set.

Number of weeks	14
Total page requests	1, 350, 004, 229
Number of distinct IP addresses	2, 769, 788
HTML requests	38.59%
Image requests	35.03%
Other requests (audio, video, etc.)	26.38%

The site is structured as a bilingual English/French site. We have considered the English content only. The trail data is very large, so we have focused on two representative weeks for our initial tests - weeks 3 and 7, a medium and a large traffic week.

3 Problem Definition

Let $D = \{d_1, d_2, \ldots, d_N\}$ refer to the set of N HTML documents present in the server. The user access history can then be expressed as, $L = \{< m_1, t_1, d_1 >, < m_2, t_2, d_2 >, \ldots, < m_M, t_M, d_M >\}$, where m_j indicates the source of the request (an IP address or a machine identifier), t_j is the server access time, and d_j is the requested document. Processing this information results in a set $S = \{S_1, S_2, \ldots, S_s\}$ of user sessions. Each session $S_j = \{d_{j1}, d_{j2}, \ldots d_{jk}\}$ indicates the order in which documents were requested by a single machine.

The goal in this work is to identify K document clusters such that user sessions span the minimum number of clusters. Thus we have to identify K clusters, $C = \{c_1, c_2, \ldots, c_K\}$, with each $c_i \subsetneq D$, such that the number of inter-cluster transitions (ICT), normalized with respect to the total number of transitions, is minimized. A transition is simply two sequential accesses in a user session. The inter-cluster transition criteria is defined in Eq. 1.

$$ICT(K) = \frac{\sum_{j=1}^{|S|} |\{< d_{ji}, d_{j,i+1} > \in T_j : d_{ji} \in c_p, d_{j,i+1} \in c_q, c_p \neq c_q\}|}{\sum_{j=1}^{|S|} |S_j| - 1} \qquad (1)$$

Here T_j represents all transitions in session S_j. The choice of K does, of course, have a significant influence on this formulation and has a major affect on the performance of any system that utilizes clustering for predictive purposes. In our current formulation, we have chosen K empirically. Even for a fixed value of K, the problem of finding the optimal value of $ICT(K)$ is practically intractable [Jain and Dubes, 1988]. Thus, we apply heuristics to perform the above clustering.

4 Method 1: Clustering Using Semantic and Trail Information

In addition to the user trail information, document content is also indicative of relationships among site pages. Consequently, we chose to initiate a study of the relationship of semantic clustering and trail clustering. Semantic clustering can be used to "bootstrap" access pattern clustering by providing an initial grouping of pages that can then be iteratively reclustered with increasing influence by the trail information. Also, semantic clustering provides a mechanism for insertion of new documents into document sets prior to the availability of trail information (document routing - [Hull et al., 1996]).

The documents at the server site are first clustered (K clusters) according to their semantic content (words in the documents). This semantic clustering consists of the following two steps: (1) *Word Clustering*: This involves extracting unique words from all documents and using them as features. Since the number of words in a document and hence, the entire set of documents at the server can become huge, we reduce the number of features. A number of methods have been described in the literature for reducing the dimensionality of the feature space (such as singular value decomposition (SVD) [Deerwester et al., 1990] and feature clustering [Wulfekuhler and Punch, 1997]). We use the feature clustering method, since it is fast and has been shown to be an efficient dimensionality reduction method. (2) *Document Clustering*: The N documents are then partitioned into K clusters using the new, reduced, feature set.

4.1 Word Clustering

Let $W = \{w_1, w_2, ..., w_M\}$ be the set of unique words (after stemming the words, removing stop words and combining words that always occur together) extracted from the N documents. The pattern matrix (with the words acting as features) for the N documents can be represented as $F_D = [f(d_1)\, f(d_2) \ldots f(d_N)]^t$, where $f(d_i) = [b_1^i\, b_2^i \ldots b_M^i]^t$ and $b_j^i = 1$, if the word w_j occurs in d_i and $b_j^i = 0$, otherwise. F_D is an $N \times M$ matrix. Since the value of M can be very large, we first cluster the words into a smaller subset prior to clustering the documents. In order to do so, we cluster the inverted pattern matrix (F_D^t, where each row now represents a word (and the N columns represent the documents) into M' clusters ($M' << M$). In our current implementation, M' is chosen empirically (500 in early experiments). We employ the K-Means clustering algorithm, with a normalized cosine-measure as the dissimilarity measure between two feature vectors. The feature clustering yields a new set of words, $W' = \{w_1', w_2', ..., w_{M'}'\}$, where $|W'| = M'$. The new pattern matrix (for the N documents) is defined as $F_D' = [f'(d_1)\, f'(d_2) \ldots f'(d_N)]^t$, where $F_D'(i, j) = 1$ if any of the words assigned to cluster W_j' occur in D_i.

4.2 Document Clustering

Having clustered the words, we next cluster the N documents into M' clusters based on the reduced dimensionality pattern matrix, F'_D. We again apply the K-Means clustering algorithm, with the normalized cosine-measure as the dissimilarity measure between two feature vectors, as the clustering algorithm.

4.3 Using User Access Information

With time, server logs with user requests become available to the server. These are then used to refine the semantic clustering performed above.

Define a new pattern matrix, $H_D = [\omega_F^t F'_D \;\; \omega_G^t G_D]_{N \times (M'+K)}$, where

$$G_D(i,j) = \frac{\sum_{k=1}^{|S|} \left[\sum_{d_m \in c_j} l_k(d_i, d_m) + I(d_i \in c_j) \sum_{m=1}^{N} l_k(d_m, d_i) \right]}{\sum_{k=1}^{|S|} \left[\sum_{m=1}^{N} l_k(d_i, d_m) + \sum_{m=1}^{N} l_k(d_m, d_i) \right]}, \; 1 \le i \le N, \; 1 \le j \le K,$$

and

$$\omega_F(i) = \sqrt{1 - \alpha^2(t)}, \; 1 \le i \le N,$$
$$\omega_G(i) = \alpha(t), \; 1 \le i \le N,$$

$l_k(d_l, d_m)$ is the number of transitions from d_l to d_m in user session k. $\alpha(t)$ is a parameter which monotonically increases with time, t. As more and more server log data become available, $\alpha(t)$ is increased to give a higher weight to user access information and a smaller weight to the semantic content in the HTML documents. Our current implementation does not change the value of $\alpha(t)$ with time, since the server and document set are fixed (we are post-processing historical data). We have empirically chosen $\alpha(t) = 0.7$. $G_D(i,j)$ is the normalized count of the number of transitions from document d_i to documents in cluster c_j and all transitions into d_i if $d_i \in c_j$. The new pattern matrix is then subjected to the K-means clustering algorithm in order to derive a fresh set of clusters. This process is repeated in an iterative fashion.

It is expected that the incremental inclusion of user session information will improve the predictive performance. As discussed in the next section, this does turn out to be true, though not to the extent expected.

4.4 Experimental Results

The first step in the algorithm is the clustering of words into reduced feature vectors. Here are some statistics relevant to the word clustering process:

Number of words after stemming and removing stop words	$19,227$
Number of words after removing words occurring in single documents	$13,105$
Number of words after combining words always occurring together	$11,002$

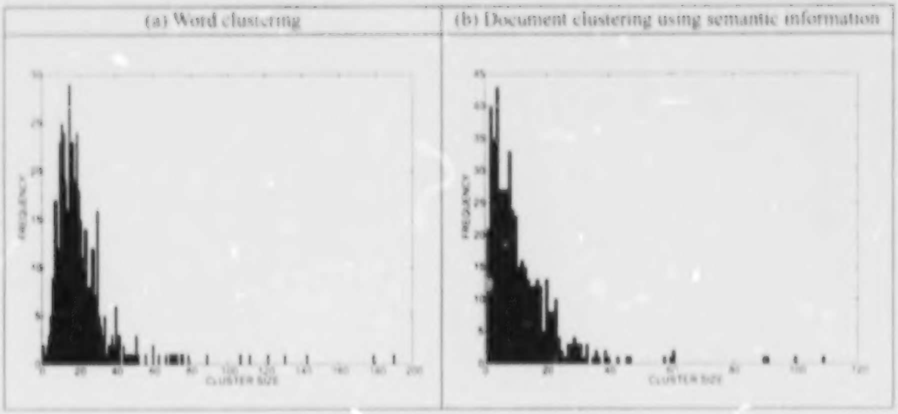
Fig. 1(a) illustrates the result of the word clustering step in the algorithm. The vast majority of clusters have word counts of around 20 words as expected, given the partitioning of $11,002$ words into 500 clusters.

While some clusters were compact (the intra-cluster error was less) other clusters had large intra-cluster errors. Members that are at distances greater than a chosen threshold could be treated as outliers and reclustered separately. As future work, we plan on performing these experiments.

The next step of the algorithm performs document clustering using the reduced-size word feature vectors. This is semantic clustering only. The number of unique HTML English documents considered was $5,841$ and the value of K was set to 500. The results of this process are summarized below:

WEEKS →	**Week 3**	**Week 7**
Number of transitions	$852,125$	$14,892,627$
Penalty	$61,069$	$14,227,220$
$ICT(500)_{SM}$	0.89	0.95

The term *penalty* refers to the number of out-of-cluster transitions. These results indicate that semantic clusters do not appear to be effective predictors of user trails. In week 3 for example, only 11% of all transitions are to pages that are semantically related. Most of the clusters, as seen in the histogram in Fig. 1(b), are reasonably sized.


(a) Word clustering

(b) Document clustering using semantic information

Figure 1: Histogram of cluster sizes

The final step in the process involves the application of the user session information. This is an iterative process, in that the clustering is based on the participation of documents in initial clusters. If the algorithm performs properly, we expect to see decreasing ICT values for each iteration. The algorithm was applied to the test data. The results are tabulated below:

WEEKS →	Week 3	Week 7
ITERATION 1	Penalty : $613,490$, $ICT(500)_{SL} = 0.720$	Penalty : $14,119,968$, $ICT(500)_{SL} = 0.948$
ITERATION 2	Penalty : $598,703$, $ICT(500)_{SL} = 0.700$	Penalty : $13,873,159$, $ICT(500)_{SL} = 0.931$
ITERATION 3	Penalty : $590,950$, $ICT(500)_{SL} =$ 0.6[illegible]3	Penalty : $13,774,633$, $ICT(500)_{SL} = 0.925$
ITERATION 4	Penalty : $588,814$, $ICT(500)_{SL} = 0.591$	Penalty : $13,861,116$, $ICT(500)_{SL} = 0.931$

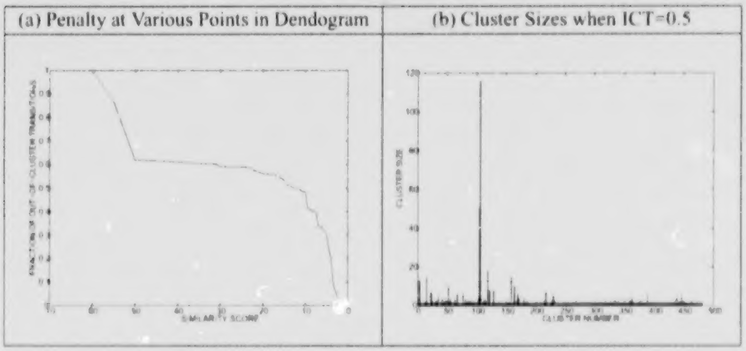
As seen above, repeated iterations do not considerably reduce the penalty and the predictive power of the method does not seem to be that useful.

5 Method 2: Hierarchical Trail Clustering

Method 1 proved to be complex computationally due to the iterative application of the K-means algorithm and the method produced rather disappointing results. Thus, we used what we had learned about the structure of the data to develop another method that does not use the semantic information contained in documents for site clustering. Instead, it uses only the trail information. This method uses the hierarchical clustering technique on a proximity matrix generated from the user trail information. In order to perform hierarchical clustering, a similarity (or dissimilarity) measure between documents must be defined. A crucial part of the hierarchical method involves updating the similarity measures after combining two documents or two clusters. For this application we chose the single-link technique which, unlike other techniques available, helps combine nodes that occur in a trail. The clustering routine generates a dendogram, which indicates the clusters and their components at various thresholds ([Jain and Dubes, 1988]).

5.1 Similarity Measure

In order to compute a similarity measure, the transition matrix was used. Each entry in the transition matrix indicates the number of transitions between pairs of documents, i.e., entry $t_{i,j}$, in the $N \times N$ transition matrix $T = \{t_{i,j}\}$, denotes the total number of transitions from document i to document j as observed from the access log. Clearly, the matrix T need not be symmetrical. However, it is an indicator of the pair-wise similarity between documents. The transition matrix is used to generate the similarity matrix $S = \{s_{i,j}\}$, which is a $N \times N$ symmetrical matrix with entry $s_{i,j}$ indicating the similarity value between documents i and j. We present below the technique that was used to transform T into S.


(a) Penalty at Various Points in Dendogram

(b) Cluster Sizes when ICT=0.5

Figure 2: Performance of the Hierarchical Clustering Technique

5.1.1 *Preprocessing I*

In order to offset the noise introduced by long trails (effect of proxy servers and/or web spiders), trails of size greater than 40 were eliminated. After preprocessing, only 866 of the 5841 documents had at least a single non-zero entry in the week 3 transition matrix. Thus the first set of experiments operated on a 866 × 866 transition matrix representing $759,640$ transitions between the documents.

To compute the similarity matrix S, the matrices T and T' were used - T' being the transpose of T. While each entry $t_{i,j}$ in T denotes the number of transitions *from* document i to document j, each entry $t'_{i,j}$ in T' denotes the number of transitions *to* document i from document j. Clearly, these values are identical prior to normalization.

1. Step 1: As a first step, all rows of T and T' are normalized as follows:
   $t_{1i,j} = \frac{t_{i,j}}{\sum_{k=1}^{N} t_{i,k}}, t_{2i,j} = \frac{t'_{i,j}}{\sum_{k=1}^{N} t'_{i,k}}$
2. Step 2: The similarity matrix is computed as follows:
   $s_{i,j} = \max\{\min\{t_{1i,j}, t_{2j,i}\}, \min\{t_{1j,i}, t_{2i,j}\}\}$

5.1.2 *Preprocessing II*

One would intuitively expect the method described in the previous section to result in reasonably sized clusters. However, results indicate (see Fig. 2(b)) that the single link technique operating on the similarity matrix constructed by this method has the tendency to form a single large cluster. In order to find out the reason for this anomaly the transition matrix was examined in greater detail. It was observed that only 287 of the 866 documents were involved in at least 100 transitions. Thus we used the following heuristic to prune the size of the transition matrix and alter it's entries: only those documents that were involved in at least a 100 different transitions (either into them or out of them) were considered. The transition matrix eventually considered 287 documents and had a total of $749,270$ transitions.

This method gave the best clustering results. Fig. 3(a) shows the fraction of out-of-cluster transitions as the number of clusters is varied by cutting the dendogram at various points. Fig. 3(b) shows the number of documents in each cluster when the fraction of out-of-cluster transitions is approximately 0.3. An ICT value of 0.3 indicates that 70% of all transistions were predicted by the clustering. In the figure it can be seen that 70% prediction is accomplished with less than 120 clusters, with a maximum cluster size of 32. Average cluster size is much smaller. There is a tendency for the clustering to emit a larger number of small clusters. We are examining ways to recluster this emitted set in order to form more uniform groupings of the site content.

6 Conclusion and Future Work

The result summarized above needs to be verified on the entire 14 weeks of the data set. We are examining this in several ways. Currently we are using the entire data set for both training and testing. We plan to partition that data set into training and testing to verify that this method is not resulting in over-fitting to the data.

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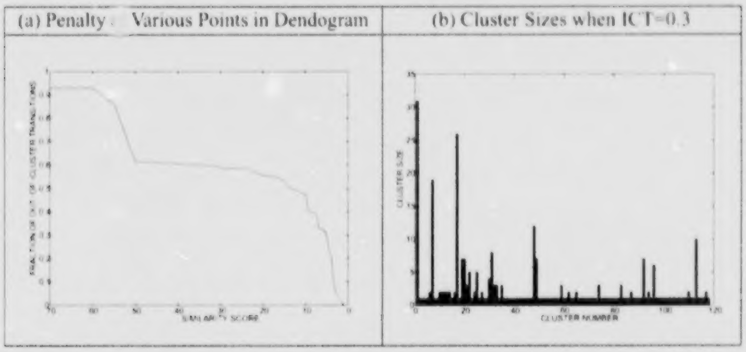
(a) Penalty at Various Points in Dendogram

(b) Cluster Sizes when ICT=0.3

Figure 3: Performance of the Hierarchical Clustering Technique after considering only those documents involved in atleast a 100 transitions

The clustering method presented in this paper necessarily produces non-overlapping clusters. While this is considered to be effective in many cases, there may be cases where common nodes exist in trails. This is particularly true if central index nodes are expected to be elements of the user trails. We plan to incorporate a technique that would facilitate generation of overlapping clusters.

The apparent ineffectiveness of semantic methods does leave the document routing problem as an open issue in this work. If new documents cannot be selected by semantic characteristics, it is not certain how they can be routed to initial clusters. As presented, the techniques in this report will ignore new documents until sufficient user history has been developed.

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A Search-Engine-Topology to Improve Document Retrieval on the Web

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Abstract: Nowadays, search-engines are the only reasonable solution for searching and finding data on the Internet. Search-engines are confronted, though, with four major problems: The Internet is growing rapidly. Search-engines cannot keep up with indexing new servers. It is becoming harder and harder to keep indexed web-pages up to date. It is difficult (or even impossible) for search-engines to index dynamically generated web-documents. Internet documents which are not based on plain text (.doc, .pdf, .class, .wav, .mov) cannot be indexed.

All of these problems are related to the fact that search-engines are only able to "act" towards web-servers like normal users. They can only obtain information via HTTP.

This paper aims at presenting an alternative approach. We will describe a topology of search-engines. The basic module is a local search-engine on the corresponding web-server and a protocol for creating the topology. Existing search-engines may use the topology in order to obtain better and faster results from web-sites.

Introduction

With the rapid growth and expansion of the Internet it became clear soon that it is not the availability of information on the Internet but the location of information which is causing problems. Search-engines were created to make those distributed information accessible. Today, there are a number of different search-engines, each based on a different approach. Some are being taken care of by editors, some are kept up to date by spiders and robots which search the Internet for new sites. All of them, though, match up in the fact that their approaches cannot cope with the real size of the Internet so that they, in consequence, cover only a fraction of the Internet. The quality of the presented data is often inadequate as well.

On the other hand, it is hard for search-engines to keep their existing score of data up to date. Meta-search-engines that are able to forward requests to different search-engines at the same time may diminish these difficulties but they cannot be considered a real solution. On the other hand, when carrying out complex requests (for example a search for a phrase or for a document containing two adjacent words) search-engines need to copy a text version of the document (which will probably be encoded) onto the server of the search-engine. This means that search-engines aiming at making the whole WWW available for requests will need an (encoded) copy of the entire WWW on the server of the search-engine. Even though hard disc storing space is getting cheaper all the time, such a venture would simply be a wasted effort. Considering this, it is not surprising that studies on search-engines conclude that only 16% of the entire WWW are getting evaluated by a search-engine and that only 42% of the WWW are getting summarized by all search-engines (Lawrence, 1999).

Dynamically generated HTML-pages are on their way to becoming the greater problem: These pages exist only while data is being transmitted to the web-server. The page is being generated after feedback with a database. It is here that robots and spider meet their limitations. An even bigger part of such data gets ignored.

The following example illustrates this fact: At an online-bookstore, the web-page of any given book can only be accessed by entering the name of the author, the title or the ISBN code. In fact, though, only a small fraction of actually available books can be accessed via the usual link-navigation.

Meantime, the Internet is increasingly becoming a kind of dump for documents which are not based on text and which, as a result, cannot be indexed. This is especially annoying when text-documents are offered only in non-textual formats (.doc, .pdf). Other documents (images, audio files, video files, or even program code) should be accessible via keywords as well though.

One last, less important, aspect is the lack of any option to influence the quality of the results of the search-query. There is neither an option to increase time for search-queries to get higher quality of the result nor an option to have e-mail posting on search queries.

In this paper, we will present a topology for search-engines as a solution for the problems described above.

One part of the solution is the definition of a new Internet protocol (IPSE = Interchange Protocol for Search Engines). The protocol is not used for determining which search-engines should deal with search-queries internally or to decide which methods to use when conducting a query. Its objective is solely to determine a frame for the communication between search-engines.

This paper pursues an entirely new approach for improving search-engines. We do not try to document the whole of the Internet and to draw out heap after heap from its hoard of information. What we do, on the contrary, is to broadcast locally available information of every server in the world.

It is an advantage that the defined topology supports existing search-engines to collect information and help to make them available faster. Thus, we can create this topology without endangering existing search-engines and without expecting all Internet-servers to support our topology from the start.

The topology described in this paper and the corresponding protocol serve as the basis for prototypes which are being developed at the moment.

The Topology

The Internet does not offer sufficient support for search-engines. The HTTP-protocol was neither invented to help search-engines with locating data nor was it created for making additional document-information available. The only way for search-engines to analyze a web-page is to first load a document, then to store it on a textual basis and after that, to indexed it. An additional task for search-engines is analyzing tags in order to generate meta-information and to locate links to other documents so that a list of supplementary documents to be visited in the future can be generated. By working through the entire list, one hopes to capture the contents of the whole web-site and of the whole WWW as well.

The question remains, though, were the greatest amount of information about one web-page is to found. It seems that the place to look would be the web-server that is displaying the website. At the present stage of research, what is missing is an adequate opportunity of presenting this kind of information to search-engines.

When creating a topology of search-engines, the initial step is a service located on the web-server to be used by search engines when accessing information via the web-site.

Such information is:

- A list of possible URLs
- Word-lists for the URLs
- Plain-text for the URLs
- Meta-information about the URLs

Initially, this service is used only by already existing search-engines for more complete and faster queries on information via a web-site.

In a second step, the service offers the possibility of replying to queries via the web-site directly. Many servers today are already equipped with an option for making query requests via the web-site. Thus, it is reasonable to implement this feature into the search-engine service right from the beginning.

The more important reason, however, is the fact that by making it possible to transfer queries to search-engine-services of different web-servers we can create a search-engine-topology.

This goes to show that query requests to search-engine servers will not always only concern local web-servers but may also have an impact on unrelated web-servers. The search-engine service is only able to reply to request queries that it is dealing with itself or that it is coaching.

The different ways of coaching will be described in the following chapter.

Being able to coach foreign web-sites as well makes it possible to give a scaling of the quality of replies.

For the purpose of taking into account currently available document resources when processing a request, the request can be forwarded to the search-engine-service that is directly connected with the web-server. In a case where it is of no importance whether information about documents are up to date or not, the search engine may operate on the local basis of data that is available at the time (nevertheless, this data might be obsolete).

There is no single, fixed procedure that search-engine-services have to follow in order to access data on another server. It can be done either by using the locally available search-engine-service or via HTTP or by using additional sources. Likewise, there is no fixed procedure for treating request queries. In the future, the quality of replies will continue to be dependent on the implementation of the search-engine.

It should be remarked here that there is a risk for the search-engine-service to be misused for presenting inaccurate information in order to get a higher access frequency on websites. It is for the search-engine service to decide which servers to "trust" and to what degree.

Push-services and e-mail-services are also possible features of a search-engine service. Push-services are used to obtain information at an unspecified period in time. This means that the flow of information will be initiated from a foreign search-engine-service and not by request.

The topological hierarchy of the search-engines will be relatively plane. The first level will contain all local search-engines - that is, search-engines that are directly connected to the web-server. The second level will be comprised of search-engines which aim either at capturing the entire Internet or which offer services specified by topic. The third level will continue to contain meta-search-engines. In our concept, search-engines will need authorization when confronting search-engine-services. This way, a scaling of request features will be possible. Access to the search-engine-service may actually be restricted to such a degree that the service will no longer be of any use for meta-search-engines trying to obtain information.

Coaching

The search-engine-service described above will be displayed by the IPSE-server. The IPSE server is the server that is implementing the Interchange Protocol for Search-Engines. Each IPSE-server is able to coach several HTTP- or FTP-servers.

We have already hinted at their being different types of coaching:

Direct coaching	The IPSE-server can directly access the document root of the associated HTTP- or FTP-server. It is able to access additional file information (e.g. meta-data or plain-text variations of documents that are not available as plain text). The server is informed about the fact that some pages are being generated by CGI scripts or by servlets. It is familiar with scripts that can carry out a dynamic generation of the URLs in question. Information about documents with partial access authorization will be given to authorized users.
Associated coaching	The server cannot directly access the document root of the associated HTTP- or FTP-server. However, the server is informed about other servers that are conducting direct coaching. The server might be able to get authorization for requesting information that has access restrictions. In a cyclic process, all the data about documents which is directly available from the other IPSE-server is being copied.
Adjacent coaching	The server cannot directly access the document root of the corresponding HTTP- or FTP server. However, the server is informed about other servers that are conducting direct coaching. The server might be able to get authorization for requesting information with access restriction. The server has to forward all requests that concern the coached party of this IPSE-server.
Foreign coaching	The server has no direct access to the document root of the corresponding HTTP- or FTP-server. The server is not informed about any servers conducting direct coaching. The server asks for all information that is available via HTTP- or FTP-protocol.

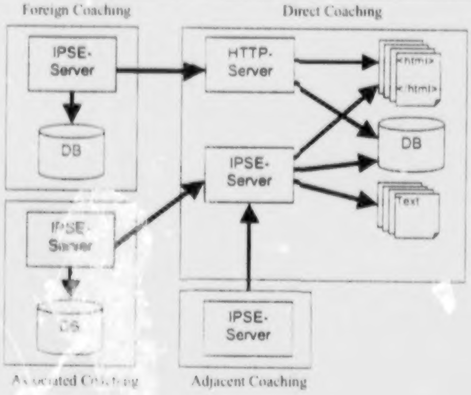

Figure 1. Different kind of coaching

Associated, adjacent and foreign coaching are all part of the type „indirect coaching". Foreign coaching works according to the same principles that are valid when search engines interact with HTTP-servers.

There is no fixed procedure to follow when setting up lists of servers on the IPSE-server. Likewise, there is no rule determining what kind of coaching is to be used for confronting HTTP- or FTP-servers. Manual configuration seems useful for specialized IPSE-servers which deal with topic-related requests – especially when the requests ask for data with access restrictions. Just like existing search engines, IPSE-servers intending to reply to requests of the general kind will continue to put their robots and spiders to work when carrying out a query. However, they will check first if there is any IPSE-server.

One sub-category of coaching is "limited coaching". Limited coaching can be used for any type of indirect coaching (associated, adjacent or foreign). In this case, it is not the entire store of documents on the foreign IPSE-server that is being coached but only a part of it. Limited coaching is necessary when specialized, topic-related IPSE-servers are being established. The IPSE-server must be configured with manual input in this case.

The protocol

IPSE is a – like FTP and SMTP – a text-based protocol (Postel, 1982/1985). It works according to the same request/reply mechanism: First, a command is being given to the IPSE-server by the transmission of a line of text. The IPSE-server replies with one or with several lines of text. The last line will start with an error code. Next, the commands defined in IPSE will be carried out.

Contrary to other protocols, IPSE has no real, fixed pattern for the internal processing of the commands. A query request may have different results, depending on the way the search mechanism has been implemented.

General commands:

HELP [<command>]	Help: Lists all commands or gives information on a specific command.
QUIT	Quit: Closing a session.

Authorization:

HELO <computer-name>	Hello: The computer name is entered as FQDN (Fully Qualified Domain Name). This is important when one IPSE-server connects to another.
USER <user>	User: Entering the user name of the user who is receiving the information. The name cannot be an e-mail address but has to be a user name that is configured in the IPSE-server. Parts of web servers protected by htaccess can be made accessible for specified users this way. It would also be possible to block entire commands for users without authorization. This depends solely on the configurability of the IPSE-server. "anonymous" is a protected user name, reserved for an anonymous access. Users who do not use the USER-command will automatically be labeled "anonymous".
PASS <password>	Password: For authorization to the system, a password is needed. Like in FTP, the password is being transmitted in plain text. A later stage of the prototype will establish a SIPSE, like SSH, SCP or SHTTP accordingly. This does not in any way influence the protocol or the structure described here

Information on coaching:

CCHG [<server-name including protocol>]	Coaching: Gives a list indicating the type of coaching or the specified server including the type of coaching.

Information on documents:

URLS <Server-Name> [date]	URLs: Gives a list of all URLS of the available documents. When entering a specific date, only URLs that have changed since this period of time will be displayed. For servers with limited coaching, only the subset of the coached URLs will be given.
LNKS <URL>	Links: Gives all the links appearing in one document.
WRDS <URL>	Words: Gives a word-list for the indicated URL and the frequency of the documents in the document. This information does not necessarily have to be derived from the document defined by the URL. The list could be derived from an alternative source if the document was not text-based or if only a part of the HTML-document had been submitted to the search – for example, because navigation text was to be ignored. Stop-lists are not used.
AWRS <Server-Name>	All Words: Like WRDS but for all coached URL's.
PLIN <URL>	Plain: Gives the plain text for an URL. Like for WRDS, this text may originate from an alternative source.
META <URL> [<meta>]	Meta: Gives all meta data of an URL or the specific meta date. Besides meta-tags which are defined in HTML-code, meta information can be derived from an analysis of the text (e.g. the title from the title tag or the transmission of the H1-tag to the keyword meta-data.) Alternative sources for meta data are also possible. Meta-data should contain at least all characteristics defined in the Dublin-core and also mime types.
UABO <Mode>	URL-subscription: The UABO-command allows to have URLs of up-dated or new documents delivered as Push-service. The mode START indicates that the user is subscribing to the service, the mode STOP indicates that the

	subscription is cancelled
ACTU <URL>	Actualized-URL: delivers the most recent or new URLs if a subscription for the server exists

Queries:

MAIL <E-Mail-address>	Mail: Defines an e-mail address for receiving the result of a query if it was an offline-request.
MODE <Modus> [<Hops>] [<Max-Time>]	Mode: Defines the type of request. L(ocal) only uses locally available data, E(xternal) uses local data only when conducting direct coaching. Requests to adjacent and associated servers get forwarded. In this case, Hops indicates the maximum number of servers that will be used for the forwarding process. If the command mode „M" is attached, the reply will be delivered a part of the mail-message. If the mode „P" is used, the information will be delivered as push-service. In both cases, the result of a request is a request-id. It is calculated by the server and is unique. If the „M"-mode was used, the request id is being delivered as part of the mail message. If the mode „P" was used, the IPSE-server initiates a connection to the requesting IPSE-server and transfers the results along with the RSLT-command. After a IPSE-servers has forwarded a request, it has to generate a reply itself. To do this, it will indicate how long it can afford to wait for the reply by using the parameter <Max-Time. If this parameter is not indicated, it depends on the configuration of the server how long it will wait for a reply.
QERY <Start-number> <number> <request>	Query: Generation of a request. For simplicity, we will refrain here from giving a detailed definition. Request syntax, nevertheless, is one of the few aspects where we are able to exercise some influence on the internal features of the IPSE-Server. Only in syntax can we test complex request options. It is up to the individual IPSE-server to implement only parts of the possible scope of the implementation. Possible operators are AND, OR, NOT, NEAR, NOT and META. The META-operator allows to request meta data. Examples: META ("MIME-Type") = "text/html" META ("DATE") "1999-12-07" META ("KEYWORDS") IN ("PAPER", "CONFERENCE", "INTERNET") The result of a request is a list of URLs (if the mode is not M or P). Otherwise, a request id will be returned. The actual results – using the request id -are transferred later on by using Push-service. Query requests are sorted according to relevance. By entering a start number and number of results the outcome can be influenced.
RSLT <ID> [<URL>]	Result: This command is used for results that get transmitted via push-service. Each located URL sets off a RSLT with request id. If the URL is missing, the transmission will be interrupted.

Summary

In this paper, we have been describing the need for a specialized service for improving the quality of search-queries. The approach discussed in this paper offers a solution to the problems mentioned in the text. Our approach is based on the simple observation that the most up-dated and far-reaching pieces of information are available on local websites and local webservers. The topology presented in this paper and the protocol defined here offer solutions that help to broadcast these pieces of information to the outside world and to reduce the amount of data stored on other search-engines as well. However, even in the future, the quality of broadcasted information will continue to depend on the quality of website maintenance. If there is no continuous proper maintenance of meta data, it will not be possible in the future to request this type of data. Administrative efforts are necessary if links to dynamically generated websites are to be made accessible. Additional examples come to mind easily. The topology presented here and the protocol that has been defined might serve as the basis for the realization of such projects.

Related Work

The approach presented in this paper does not take into account how different documents are related to each other by context. Our approach does not give credit to the objective of the „Semantic Web" (Berners-Lee, 1999). The problem of trying to capture the vastness of the Internet must be detained for yet another 'period of grace'.

At the time, WebDAV (WebDAV, 2000; Slein 1998) is trying to built an extension for HTTP which allows users to collaboratively edit and manage files on remote web servers. Our approach does not contradicts this. WebDAV does offer more information about documents, but was not built as a platform for a search-engine-topology.

One spin-off of the effort to define WebDAV was the definition of the DASL-protocol (DAV Searching and Locating) (Reddy, 1999). DASL concentrates on request features. It does not emphasize on the topology where the protocol is been used.

Several efforts have been made to see the WWW was as a big database. Special languages have been developed to declare questions about web-contents (Mendelzon, 1996; Konopnicki, 1995; Lakshmanan, 1996;

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Fiebig, 1997). These languages give not an answer to the question how the information could be made available. They only allow flexible questions about information that is already available. A good place for such languages would be the QERY-command in our protocol.

Our approach of a search-engine-topology can be compared with the architecture of mediator-systems to handle semi-structured data (Liu, 1996; Levy, 1996; Abiteboul, 1997; Chawathe, 1994; Hammer, 1997). In such a system our IPSE-Server would have the function of a mediator and of a wrapper of web-servers. These architectures are not especially built for the internet and have a more general approach of semi-structured data. So they do not consider the web-specific problems.

IPSE is only a means for creating a search-engine topology. It has kept problem-focused and simple on purpose. We have abandoned here to implement a feature for transmitting data in the XML-format.

However, changes in the strategy would neither affect our approach nor the topology.

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Organizing Information for the Canadian Design Engineering Network

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Abstract: The author reports on a universal searchable index of Web resources for design engineering. The project is part of the Web site for the Canadian Design Engineering Network (CDEN), a recently funded national initiative to provide a mechanism for design engineering practitioners, educators, and others to access recent information on the field, to collaborate, and to help student learn design engineering. The searchable index, the CDEN Online Resource Catalog (CORC) is a simple set of CGI scripts working in conjunction with an existing Web indexing robot (Swish-E), and with a human "reviewer", to bring online quickly a large portion of the available Web resources on design engineering. Besides its use to provide access to relevant resources, the author intends to use CORC to discover the organizational structure of design engineering information – such a structure could be valuable to both design practitioners and researchers.

Introduction

The Canadian Design Engineering Network (CDEN) is a new national initiative to promote design engineering, with particular emphasis on undergraduate curricula and the training of highly qualified personnel. CDEN will consist of partners from academia, industry, and government, and is being constructed in a "grass-roots," bottom-up fashion. Although the network's rallying cry is "A network of people, not computers," it is also understood that an information technology infrastructure is fundamental to success. A Web site was identified as the single central access point by which all members of the network would access uniformly the facilities that CDEN will have to offer. In order to provide uniform access and search capabilities, consistent cataloging and navigational models are required. The mechanism that is being implemented to provide this universal searchable resource index – called the CDEN Online Resource Catalog (CORC) – is the subject of this paper. Since CDEN has only recently received its initial seed funding, the focus of this paper is on defining the problem to be solved and outlining the approach to be taken; it may be seen as a case study in the design of an application-specific Web site index.

Even while the CDEN funding proposal was being prepared, a set of requirements for the network's Web site were being assembled:

1. Ease of use and navigation would be a key priority, especially in light of the wide variety of resources we expect to have online eventually including online lectures, tutorials (interactive and otherwise), Web-based design aids, design projects, etc.
2. Many existing design engineering resources are unknown to the Canadian design engineering community, and many new resources are becoming available each year. In order to encourage contributions from CDEN members, but to simultaneously expedite gathering of references to pertinent resources, an "open authoring" concept would be used to gather resource references, and a Web robot would then explore them and related sites to expand the database quickly.
3. While computer network resources are fundamental to a national initiative like CDEN, they are also secondary to the mandate of promoting design engineering in education. So the expenses in time and money associated with the computer-based aspects of the network were to be kept as low as possible.
4. It is important that at least some computer tools be developed "in house," as doing so affords CDEN control over those resources, and the chance to develop innovative tools to share with its members; thus, outsourcing software development and maintenance tasks was not seen as a viable near-term option.

5. CDEN has certain well-defined activities that have been specifically funded. However, due both to the historical isolation of design engineering researchers and educators from one another within the Canadian university system, and to certain inherent questions surrounding design engineering, it is unclear at this time how a collection of Web resources could be organized to optimize accessibility. Thus it was considered important that the software to be developed for CORC be as flexible as possible, to respond to the inevitable changes in the activities pursued as the network matures.
6. Although Web access to resources related to design engineering is increasing rapidly, it was recognized that the amount of available material was only a small fraction of the total content of the Web. This means that the facility does not need to handle large databases (at least in the near term). Thus, a "low-tech" approach was adopted, where preference was to be given to functionality and easy maintenance rather than efficiency and speed.
7. Finally, it is hoped that CORC will provide the kind of data needed to allow the internal structure of design engineering information to emerge; the results of which could be valuable to information retrieval, information technology, and design researchers.

With these criteria in hand, CORC is being designed and implemented.

CORC's Architecture

Three Alternative Architectures

Various overall architectures were considered for CORC. A Yahoo-like directory structure was considered, wherein resources would be categorized into a fixed hierarchical structure, but four fundamental problems with that approach were identified. Firstly, there is little consensus in the design engineering community regarding the nomenclature of design. For example, the design of a chemical plant, of an automobile engine, and of an IC chip, are significantly different classes of problems, not just with respect to the sciences involved, but also with respect to the problem-solving techniques and general processes used. Without a well-accepted nomenclature for classifying information sources, accessibility would be compromised. Secondly, as a result of the first problem and due to the inherent interdisciplinary nature of design engineering, many resources would appear in many different categories; this kind of duplication was seen as undermining the goal of providing a useful categorization. Thirdly, the author was dissatisfied with the navigational features of portals arranged to the Yahoo model, particularly the depth of hierarchy. In combination with the cross-referencing problem, deep hierarchies were seen as ineffective navigational mechanisms for CORC. Finally, in order to "manually" categorize all resources, the editorial staff would have to have quite deep knowledge of various highly technical areas; the author believes this would unnecessarily hindered the growth of CORC's database.

Another option was to use a keyword-only approach, and to adopt an "intelligent" query engine and database system, such as that used at Google (http://www.google.com). In this model, there is no explicit categorization of resources (one has been added to Google since the first writing of this paper); the cost of categorizing references manually is eliminated. The user interface is also very simple to use and easy to maintain. Although there is an assumption that the content provider will use appropriate keywords, it is more likely (though by no means certain) that the assumption holds in a restricted and highly technical domain like design engineering, than it is for the Web in general. Furthermore, a keyword-based query engine can be used to discover queries that yield largely disjoint sets of resources – thus allowing categories to emerge with time. However, two problems were identified with this approach as well. Firstly, the development or purchase of the appropriate database and query engine software was seen as conflicting with CORC's basic requirements, as well as requiring more time to set up than we could afford (as a near-term solution, at least). Secondly, there are inherent limitations in the use of keyword-based searching, stemming from the various different connotations of words and the contexts of their usage, which are rarely captured by search engine databases (Lawrence & Giles 1998). This problem is exacerbated by the ambiguity of often-used technical terms in design engineering (such as "function" versus "behavior" of products).

A third architecture involved the use of a Web robot. The robot would automatically gather and index relevant pages. However, again, the author was unable to find any cost-effective ready-made solutions. Furthermore, while it is easy to write a Web robot with tools such as the LWP module in Perl (http://www.perl.com/), it is very difficult to "explain" to the robot how to identify relevant Web pages for a single domain. As an example, the Swish-E

(Hewlett-Packard Co 2000) robot was used on a test run of an index file containing references to 20 pages that are highly relevant to design engineering; the robot pursued links to a depth of four. The resulting index contained references to 359 files; but a search of the database for the keyword "design" yielded only 134 hits. (Note: Swish-E is normally for use on single sites only; the code was altered by the author to function across the entire Web.) So, even starting with what would be considered an "authoritative" site, a relatively shallow search that does not analyze each page for relevance will yield a database containing many anomalous entries.

A Blended Architecture

All three candidate architectures mentioned above have advantages, but each also has serious disadvantages. The author therefore sought to combine aspects of all three architectures so that the advantages would remain, but the disadvantages would be offset by other system components.

Selection and categorization of resources is done "manually," by an editor (currently, the author). Resources may be submitted for editorial review by anyone. The system keeps track of resources to be reviewed as well as those that have been previously rejected. A CGI script presents to the editor a form for each potential new resource, including links in that resource that have been neither (a) already included in CORC, nor (b) rejected in a previous review session. The reviewer selects then visits the resource to judge its relevance. If the resource is to be added to CORC, the reviewer selects a set of appropriate categories for the resource (see the next section for details). Whether the resource is accepted or rejected, the editor may also select any links in the resource that should also be reviewed; these links are added to the list of "incoming" resources. In this sense, and given the other requirements on this project, the author sees this approach as "human-aided computing."

CORC consists of two separate databases: one that maps categories to resources, and the other that maps keywords to resources. The second database is regularly rebuilt using a Web robot that downloads and indexes approved resources by keywords extracted from the resources. A CORC query consists of at least one category, plus any optional keywords specified using boolean connectives. The response is constituted of those resources that match the conjunction of all the categories with the keyword query.

The current version of CORC is implemented mostly in Perl. The Swish-E indexing system is used to generate the keyword database; Swish-E as distributed is used for local Web site indexing only, but the author has modified the code to operate on the Web at large. It should be noted that there are many other Web-based technologies that could be (and likely will be, in the future) used in CORC, such as RDF, XML, etc. However, the author's examination of existing design engineering Web resources indicates that the use of these technologies is not yet prevalent enough to warrant their use in CORC at this time.

Facet-based Categorization

CORC's categorization system is "facet-based." Facet-based classifications are very popular in information retrieval systems (Wesley-Tanaskovic et al. 1994, Pollitt 1997). Their underlying principle is that there are many different ways of categorizing information sources, all of which (a) are pertinent and (b) may be combined to product very rich queries. Each different categorization constitutes a "facet," and each facet in a group of facets should highlight one particular characteristic of division of the materials. For example, one may categorize publications by one facet for its kind (article, book, conference paper, etc.) and by another for its targeted audience (technical experts, general practitioners, students, etc.). A facet-based query may consist of categories selected from only one or from many facets.

A facet-based approach was chosen for CORC because: (1) it allows the same keywords to be used in different contexts, thus avoiding the nomenclature problem; (2) it simplifies maintaining databases where each resource may appear in many different categories; and (3) the very shallow hierarchy of categories resulted in a simpler navigational model.

Developing the appropriate facets is key. Typically, facets are "mined" from the content being indexed, and various AI techniques are used to expedite this process. However, due to the importance of the launching the system quickly and the fact that no well-accepted overall ontology of design engineering exist, an initial set of facets was developed based on (a) the activities identified in the CDEN funding proposal, and (b) the author's own experience in design engineering research. While the resulting facet set (see Appendix A) is obviously suspect, it is a starting point for future development (see below). The facets that are labeled "CDEN-specific" are those arising from the activities that CDEN expects to support – there is little that can be done to rearrange those. The other facets represent different ways of classifying the various resources. A particular resource is classified against all facets which pertain substantially to that resource. That is, a resource that, for example, does not *directly* address any of the product *life cycle phases* will not be classified in that facet at all.

Discussion

Some issues have come to light in the course of designing CORC that were not evident at the outset, yet will impact significantly on its performance and utility. These issues are discussed here.

Rather than attempting to implement a purely computer-based Web robot to collect only resources relevant to design, the system leverages the human ability to quickly recognize pertinent resources ("human-aided computing"). This keeps the software simple and the database content development relatively quick. For example, assuming an Internet connection with sufficient bandwidth, one may easily access a Web page and decide on its relevance to design engineering in two minutes (this includes performing the facet-based categorization as well). Let us assume that there is one professor interested in design engineering at each of the 34 Canadian engineering schools, and that each professor has one post-graduate student who will dedicate 30 minutes per week to selecting Web resources for CORC. At this rate, over 25,000 resources will be added to CORC in one year. This author suspects that the total number of relevant design engineering sites currently accessible is far less. Therefore, we can expect a substantial portion of all relevant Web resources to have been incorporated into CORC within one year of its launch.

The combination of general categories and specific keywords should dramatically reduce the number of anomalous resources that are included in the database. For example, there is a facet in CORC that distinguishes resources based on the kind of publication it is: an article, a web site, a mailing list, etc. This kind of information is rarely distinguishable easily by software based solely on a site's content. But it is very easy for a human editor to manually select the best facet for a given resource. Keywords can then be used to identify particular publications in the database. Using keywords allows the number of necessary facets to be quite small; and the use of the facets gives a depth of categorization not possible with keywords alone.

Extensive logging of usage is carried out to provide the author with data the analysis of which will lead to improvements in quality of results returned by queries. Every query is fully logged (including the list of URLs that were returned as response). Analysis of the queries will identify common combinations of facets and keywords; facets that are not commonly used may be removed altogether; keywords that are very common may be added as new facets. Clearly the results of any such analysis are only as good as the data being searched. That is, if there are no entries in the database for the keyword "quality," for example, then users will quickly learn not to use that keyword, which in turn will indicate that it should not be a facet. But as the size of the database grows, and as Web sites and pages are changed and updated by their authors, that situation can change. Thus, query analysis will have to be an on-going concern over the life of CORC. Furthermore, when query results are returned by CORC, links to matched resources are made via an HTTP style redirection through CORC itself. In this way, the system can log every visit to any resource reference in CORC's database. Thus, "popular" sites can be identified and site rankings can be altered to take this into account. In CDEN's domain, popularity can be a very important indicator.

The sites that are to be part of CORC's database are sites of technical and pedagogic value to design engineering educators, researchers, and students. A site of this type that becomes popular with students should probably be considered pedagogically valuable. But an important issue in this regard is the nature of the user community that makes the queries. A CORC user may be a junior or senior undergraduate student, a graduate student, a researcher, a practicing design engineer in industry, an engineering manager, or a government official. Each user community will have different expectations and will consider a site to be of different value than will user communities. The effect that this variation will have on the analysis of usage data is unclear, but the author expects it to be noticeable and important.

Future Work and Conclusions

As of this writing, a development version of CORC is online and available at http://deed.ryerson.ca/cgi-bin/corc/corc, however, its database contains only a few dozen sites; many more are waiting for review by the editor. There are three significant areas that are of immediate concern to the author.

Firstly, more research needs to be done in the area of faceted classifications; this project has clearly only scratched the surface of what may be possible in this regard. A deeper survey of the literature in this area is on going, and should lead to substantial improvements in the facet-based components of CORC.

Secondly, although design engineering is not as formalized as other engineering sciences (such as thermodynamics, etc.), it does enjoy some structure, which will be reflected in the content of Web resources on the subject. This leads the author to believe that a study of the keywords that appear in the resources that CORC will contain after its first year of operation could be used to further our understanding of design engineering, by providing a broad ontology of the concepts that compose it. This analysis will involve searching the various resources for groups of keywords (i.e. queries) that separate the database into disjoint subsets. The complexity of an exhaustive search for such queries is probably NP-complete at least. Nonetheless, the author expects to find some interesting groupings using genetic algorithms, and accepting that categories will likely overlap slightly – rather than being cleanly disjoint – if for no other reason than the ambiguities of certain terms (such as "feature," for example). Such queries may lead to the introduction of new facets, or may form the basis of a general ontology for design engineering (assuming that the Web resources referenced by CORC will be representative of the total body of available information about design engineering).

Finally, the relationship between the user communities who will use CORC and the value or rank that those communities place on various resources will hopefully suggest areas that, for example, students are highly interested in learning about, or that they have significant difficulty learning about. Also, analysis of queries made by practicing designers may highlight issues of concern to industry that can be treated via appropriate research.

Clearly, a great deal of work remains to be done on and with CORC. Its central role as universal access point for design engineering resources will be attained only if it is useful, simple, and reliable. Setting aside issues of software reliability, it is hoped that the somewhat atypical model used to implement CORC will result in a more functional program, and that data gathered from its use will be of consequence to design researchers and to others interested in organizing the Web.

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Appendix A: CORC Facets

CDEN-Specific Facet Groups

Design Skills	Communication, teamwork, process/methods
Courseware	Guest lecture, case study, lecture module, industrial design module, demonstration

Design Projects	Junior, senior, competitions, gallery, industry-specific
Resources	Facilities, interactive, graduate students, evaluation and examination
Innovation	Technology, program development, entepreneurship, faculty development

Other Facet Groups

Class	Journal, article/book, conference, newsgroup, mailing list, reference
Sector	Industry, business, education, government, research
Discipline	Civil, computer, electrical, industrial, manufacturing, mechanical, nuclear, software, systems
Life Cycle Phase	Management, requirements, conceptual, functional, embodiment, detail, analysis, fabrication, assembly, testing, operations, end-of-life
Focus Area	Environmental, product design, electronic packaging
Application	Aerospace, automotive, ergonomics, mechatronics, power, robotics
Structure	Person, group, company, organization/society/agency, university

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CADAL Quiz: Providing support for self-managed learning?

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Abstract: A Web-based multiple choice quiz generator and assessment tool, CADAL Quiz (Computer Aided Dynamic Assessment and Learning Quiz), was developed at Monash University and has been incorporated into a number of subjects within the Faculty of Information Technology. CADAL Quiz generates random quizzes on any topic selected from pre-defined lists of topics. This paper describes the use of CADAL quiz in three undergraduate computing subjects which taught programming in Visual Basic and COBOL. It was primarily introduced by the lecturers to promote self-managed learning. The paper examines the impact of CADAL Quiz as a motivational resource and studies the effectiveness of computer aided assessment as a formative and summative self-assessment tool by analysing the student usage of the quiz over a semester. The students' quiz scores, time and frequency of accesses are considered. These statistics generated by CADAL have provided lecturers with feedback about the students' pattern of usage of this Web-based resource.

Introduction

The widespread acceptance of the World Wide Web in our tertiary institutions and the community has provided the opportunity for the development of new types of resources to assist students in their learning. The Web environment facilitates the development of interactive teaching resources incorporating multimedia and graphics. These types of resources can provide immediate feedback and visual interest, encouraging students to actively participate in the learning process. Web-based resources allow flexibility of access on or off campus and at any time, providing students with support for independent and self-managed learning.

An example of a Web-based teaching resource is the interactive quiz generator (Byers 1999; Tinoco, Fox & Barnette 1997). At Monash University, CADAL Quiz (Computer Aided Dynamic Assessment & Learning Quiz), a Web-based quiz generator, has been developed and is being used in a number of subjects within the Faculty of Information Technology. CADAL Quiz is an interactive Web-based tool for the generation of random quizzes (Carbone, Schendzielorz & Zakis 1997). It provides facilities for immediate feedback of results to students and lecturers and the recording of students' results.

This paper reports on the use of CADAL Quiz in three undergraduate computing subjects. One subject teaches introductory programming in Visual Basic and the other two subjects teach programming in COBOL, one at an introductory level and the other assuming a prior knowledge of programming. CADAL Quiz was incorporated into these subjects to provide a resource to enable students to test and monitor their knowledge on different topics covered in lectures, and provide a revision tool for examination preparation. At any time throughout the semester students were able to use this facility to generate unique quizzes that were marked automatically and provided immediate feedback.

Educational Motivation and Rationale

The primary reason for the introduction of CADAL Quiz into the three programming subjects was to provide students with support for self-managed learning. The lecturers felt that the use of the quiz during the teaching semester would help reinforce concepts introduced in the lectures and provide links between lectures and practical classes. Learning to program is an incremental and a cumulative task, each new topic usually building on previous topics (Liffick 1996). It is therefore important for successful progress through a programming course that students work consistently and keep up to date with their work.

The lecturers of these subjects were committed to providing environments that encouraged active engagement in learning (Affleck & Smith 1999). This fits within the constructivist pedagogical paradigm which maintains that learning is actively constructed rather than acquired. It was hoped that the immediate feedback provided by the quizzes would motivate the students to engage in the learning process consistently throughout the semester. Butler and Winne (1995) view feedback as important to the stimulation of cognitive processes in the learner that may enhance future learner engagement. Continuous formative self-assessment has been found in other studies to enhance student performance in subsequent tests (Sly & Rennie 1999).

Another motivation for the introduction of CADAL Quiz was to enable lecturers to monitor students' understanding of different concepts from the feedback that CADAL Quiz provides to quiz administrators (Cox & Clark 1998).

Features of CADAL Quiz

CADAL Quiz is a Web-based multiple choice quiz generator and assessment tool. CADAL Quiz uses a set of scripts that are invoked by the Web to construct and generate quiz questions, check and record answers, and store relevant statistics in a database. It has two interfaces: the lecturers' interface which provides facilities to construct sets of quiz questions and view test results, and the student interface which allows students to select and submit answers to a quiz for a particular topic, and provides feedback on their results.

Some of the special features of CADAL Quiz are:

- Random ordering of questions and the options for quiz generation
- Subduing the randomness and specifying a question breakdown for quiz generation
- Immediate assessment with logged details.
- Results optionally displayed to the student.
- Results optionally emailed to subject staff.
- Results and statistics can be graphically viewed online.
- Restricted access to quizzes and secure staff areas.

Integration of CADAL Quiz into the Subjects

In 1999 CADAL Quiz was introduced into the three undergraduate computing subjects considered in this study. Over the semester a database of quiz questions was constructed for the Visual Basic subject and another combined database was constructed for the two COBOL subjects. Each week questions relating to the week's lecture topics were devised and entered into the databases. Each database was organised into topic areas, and each topic contained from 20 to 40 questions. These questions aimed at testing whether the students had understood the concepts covered in the lectures.

When students accessed CADAL Quiz they nominated a topic area from a predefined list. They were then presented with a random selection of 10 questions relating to that topic. Each time the students accessed the quiz they were presented with a different selection of questions. Students were encouraged to attempt CADAL Quizzes throughout the semester as many times as they wished for self-assessment purposes only.

Patterns of Student Usage of CADAL Quiz

CADAL Quiz was integrated into the Visual Basic and COBOL subjects primarily as a support mechanism to encourage students to continually test and monitor their knowledge on different topics covered in lectures throughout the semester. However, it was also designed to help them with revision for formal assessment. The students' results for each test attempt were recorded, providing statistics to measure the student usage of CADAL in these subjects.

Student Usage of CADAL Quiz in the Visual Basic Subject

A total of 92 students were enrolled in the Visual Basic subject. Over the whole semester a total of 2467 accesses were made to CADAL Quiz by these students. This is an average of approximately 27 accesses per student, however when individual accesses are examined there are some extreme cases which distort this figure. The highest number of access was 90 for one student and 12 students accessed the quiz more than 50 times. All students accessed the quiz at least once.

The distribution of all quiz accesses over the semester is shown in Table 1. The database of topics was built up over the semester. The first topic (topic 1) was introduced in week 2 and the other topics in the weeks following. The distribution of accesses for topic 1 is also shown in Table 1. As can be seen from this table most of the accesses were made immediately prior to, and during the week of, the mid-semester test in weeks 6 and 7 (34.7% for all topics and 42.1% for topic 1), and during the examination period (25.3% for all topics and 12.1%% for topic 1). It appears that most students were using CADAL Quiz for revision for formal assessment. The lowest numbers of accesses occurred in weeks 8 and 13 when the assignment work was due.

Week	All topics		Topic 1	
	Number of accesses	Percentage of total accesses	Number of accesses	Percentage of total accesses
1-5	192	7.8	110	23.4
6 (non teaching)	282	11.4	58	12.3
7 (test week)	576	23.3	140	29.8
8-14	792	32.1	105	22.3
15 (exam period)	625	25.3	57	12.1
Total	2467	100	470	100

Table 1 CADAL Quiz accesses for all topics and topic 1 for the Visual Basic subject

The CADAL Quiz question database for the Visual Basic subject contained 11 topics. The number of accesses for each topic and the average scores obtained expressed as percentages are shown in Table 2. The topics are shown in the order they were presented during the semester. At the end of the semester the students were asked to rate the difficulty of concepts in each topic on a 7 point Likert scale (1 indicates the topic was very difficult and 7 indicates the topic was very easy). These results show that the number of quiz attempts tended to decrease for each new topic presented except in two instances. An interesting observation is that the number of quiz attempts decreased as the topics increased in difficulty, in particular the most difficult topics (sequential access files and random access files) were attempted the least amount of times.

Description	Attempts	Average score	Difficulty rating
Introduction	746	76.5	N/A
Variables and types	315	73.5	5.3
Selection	279	79.9	5.5
Input/output	256	70.2	N/A
Iteration	142	63.6	4.9
Arrays	118	63.8	4.6
Menus, drawing objects	129	64.3	N/A
Multiple forms	114	57.8	5.6
User defined types	105	64.0	5.0
Sequential access files	88	66.8	3.7
Random access files			3.8
Subroutines and functions	96	66.0	4.3

Table 2 CADAL Quiz accesses, average scores obtained and difficulty rating for each Visual Basic topic (N/A is used where the difficulty rating was not available)

Student Usage of CADAL Quiz in the COBOL Subject

A total of 155 students were enrolled in the two COBOL subjects. Over the whole semester a total of 2478 access were made to CADAL Quiz by these students. This is an average of approximately 16 accesses per student, however, as with the Visual Basic subject, there are some extreme cases that distort this figure. The highest number of accesses was 96 for one student and 12 students accessed the quiz more than 50 times. A total of 33 (21.3%) students accessed the quiz only once or not at all.

The distribution of all quiz accesses over the semester is shown in Table 3. The database of topics was built up over the semester as was done with the Visual Basic database. The first topic was introduced in week 2 and the other topics in the weeks following. As can be seen from this table most of the access (83% for all topics and 71.3% for topic 1) were made after the teaching semester had finished and during the examination period. It appears that most students were using CADAL Quiz for examination revision. The lowest numbers of accesses occurred in weeks 8 and 13 when the assignment work was due. This follows a similar pattern to the Visual Basic subject.

Week	All topics		Topic 1	
	Number of accesses	Percentage of total accesses	Number of accesses	Percentage of total accesses
1-10	292	11.8	100	22.7
11 (non teaching)	59	2.4	10	2.3
12-14	71	2.9	17	3.8
15-17 (exam period)	2056	83.0	314	71.3
Total	2478	100.0	441	100.0

Table 3 CADAL Quiz accesses for all topics and topic 1 for COBOL subject

The CADAL Quiz question database for the Cobol subject contained 9 topics. The number of accesses for each topic and the average scores obtained expressed as percentages are shown in Table 4. The topics are shown in the order they were presented during the semester. The students in an end of semester survey were asked to rate the difficulty of concepts in each topic on a 7 point Likert scale (1 indicates the topic was very difficult and 7 indicates the topic was very easy). These results show that the number of quiz attempts decreases for each new topic presented, and the perceived difficulty of the topics increases.

Description	Attempts	Average score	Difficulty rating
Introduction, variables and types	441	74.1	5.1
Selection, iteration	371	68.1	5.1
Field editing	283	63.9	4.3
Sequential files	255	75.2	4.4
Indexed files	274	69.6	4.2
Subprograms	219	63.7	4.1
Arrays	237	65.6	4.2
Text processing	157	64.0	4.1
Control break processing	241	60.1	3.9
Total	2478	66.4	

Table 4 CADAL Quiz accesses, average scores obtained and difficulty rating for each COBOL topic

CADAL Quiz as a Revision Aid

Students in all three subjects were encouraged to use CADAL Quiz to revise for their final examinations. The Visual Basic students were also encouraged to use it for their mid-semester test. The large number of accesses prior to the examinations and test suggests that many students did this. When the pattern of accesses is further examined it is evident that many students did not use CADAL Quiz at all until examination revision time.

The major assessment component of both subjects was an end-of-semester examination. Each examination paper contained two sections: Section A was a multiple-choice section testing declarative knowledge and Section B contained short answer, problem solving, and programming type questions to test functional knowledge. To determine if there was a relationship between students' scores in Section A and Section B of the examination, Pearson's product moment correlation coefficients were calculated. A correlation coefficient gives a measure of the degree of a relationship between two variables. Correlation coefficients were calculated for each subject. The correlation results were all significant at the 0.01 level indicating a consistent and stable assessment across both components of the examinations. The results are shown in Table 5. Similar results were found by Farthing and McPhee (1999) in statistical comparisons of students' results in multiple choice tests and examination results.

Qualitative investigation of the quiz accesses however shows that the few students who used the quizzes extensively scored higher results on Section A (multiple-choice section) of the examination paper than Section B. This raises the issue of the relationship of this type of quiz to self-managed learning that we were unable to explore further with the data obtained.

Subject	Pearson Correlation	
Visual Basic	0.73	*
COBOL (Introductory)	0.79	*
COBOL	0.61	*
* Correlation significant at the 0.01 level		

Table 5 Results of correlations between Section A and Section B of the final examination

Discussion

CADAL Quiz was intended by the lecturers to be used by the students as a continuous self-assessment tool to provide assistance for self-managed learning. The patterns of usage however suggest that most students were not doing this, particularly in the COBOL subjects, where for more than half the weeks in the semester the accesses were less than 1% of the total accesses, and more than half the students did not access the quiz at all until the exam revision time

The student usage patterns show a definite bias towards its use as a revision tool for formal assessment. The Visual Basic students used the quiz most frequently before the mid-semester test and final exam. Over 60% of the accesses in this subject were in the weeks prior to these two assessment tasks. However, in the COBOL subjects over 83% of the accesses were in the exam revision time. The COBOL students had a longer exam revision period and this may account to some extent for the higher percentage of accesses at this time than the Visual Basic students.

The Visual Basic students showed a higher and more consistent use of CADAL Quiz. The Visual Basic students had an average of 2.4 accesses per person per quiz compared with 1.8 accesses for the COBOL students. All the Visual Basic students used the quiz at least once whereas 21% of the COBOL students used the quiz only once or not at all. The higher usage of CADAL quiz by the Visual Basic students may indicate that this type of resource is of more value to introductory programming students.

There were some high users of the quiz in both groups, with 12 students accessing the quiz over 50 times and one student in each subject accessing the quiz at least 90 times. The quiz generates random selections of questions from a selected topic. Some students were observed to generate the quizzes many times in an attempt to obtain all the possible questions. These students indicated that it was their intention to study these questions for the test or exam. This approach of memorising solutions to questions defeats the intention of the lecturers to provide a learning environment for students to reflect on their understanding.

Conclusion

CADAL Quiz was introduced into three programming subjects with the intention of providing students with a means to monitor their own understanding of concepts during the semester and as a motivation for them to become active learners. The students in each subject showed similar patterns of usage. Most students were enthusiastic users of CADAL Quiz as a revision tool for their formal assessment. However, only a small percentage of students used it for self-assessment during the semester and their usage decreased when assignment work was due and when the topics increased in difficulty.

The CADAL Quiz generator is an application of World Wide Web technology that may have a significant impact on educational assessment materials on the Internet. The quizzes are interactive, dynamically generated and are available at the students' convenience. Although the lecturers in our study viewed CADAL Quiz as an important support tool for encouraging independent, self-managed learning, to the students it was more valuable as a revision tool for their formal assessment.

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Mining the Most Interesting Web Access Associations

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Abstract: Web access patterns can provide valuable information for website designers in making website-based communication more efficient. To extract interesting or useful web access patterns, we use data mining techniques which analyze historical web access logs. In this paper, we present an efficient approach to mine the most interesting web access associations, where the word "interesting" denotes patterns that are supported by a high fraction of access activities with strong confidence. Our approach consists of three steps: 1) transform raw web logs to a relational table; 2) convert the relational table to a collection of access transactions; 3) mine the transaction collection to extract associations and rules. In both step 1 and step 2, we provide users with an effective mechanism to help them generate only "interesting" access records and transactions for mining. In the third step, we present a new efficient data mining algorithm to find the most interesting web access associations. We evaluate this approach using both synthetic data sets and real web logs and show the efficacy, efficiency and good scalability of the proposed mining methods.

Introduction

The World Wide Web is rapidly emerging as an important communication means for the dissemination of information related to a wide range of topics (e.g., education, business, government, recreation). In order to organize a website well and provide the most attractive and valuable information to users, the designer is usually very interested in understanding the access behavior and patterns of the users. Data mining techniques (Agrawal et al. 96, Garofalakis et al. 99, Kwedlo et al. 98, Mobasher et al. 96, Shafer et al. 96, Shen et al. 98) can aid in the extraction of these useful access patterns by analyzing historical web access logs.

We are developing a web log mining system, which aims to discover useful web access patterns like association (Agrawal et al. 93) and classification rules (Shafer et al. 96) based on users' interests. Figure 1 shows the overall structure of our current system. The goals of this research are twofold. On one hand, we design new efficient data mining algorithms and use web logs as real data sets to test their performances. On the other hand, we study how to apply our algorithms or adapt existing data mining techniques to web access pattern mining. Our system currently consists of three modules: 1) association miner: finds correlations between pages that are often accessed together; 2) decision tree classifier: creates a decision tree to do classification (e.g., classifying webpages based on access attributes like domain type, time and method of the request) (Shafer et al. 96); 3) evolutionary approach (EA) classifier: uses EA (Kwedlo et al. 98) instead of decision tree based approach to generate classification rules. In this paper, we focus on the first module and present our approach on mining the most interesting web access associations, where the word "interesting" denotes patterns that are supported by a high fraction of access activities with strong confidence.

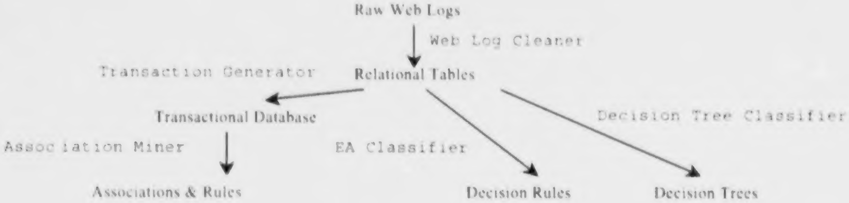

Figure 1: Web access pattern mining system structure.

Association rules, introduced in (Agrawal et al. 93), provide a useful mechanism for discovering correlations among items belonging to customer transactions in a market basket database. An association rule has the form X => Y, where X and Y are sets of items or itemsets. Let the support of an itemset X be the fraction of database transactions that contain X. The support of a rule of the form X => Y is defined as the support of $X \cup Y$, while its confidence is the ratio of the supports of $X \cup Y$ and X. The association rules problem is that of computing all association rules that satisfy user-specified minimum support and minimum confidence constraints.

In the web log mining context, we are interested in finding associations like "x% of the people who visit page A also visit page B". Generally, this type of patterns can give some guidance to website designers about what pages should be linked or what contents should be placed together. Discovery of such rules for organizations engaged in E-Commerce can help in the development of effective marketing strategies. This can also help in educational systems. Many professors have been using the Web as an important means to make announcements, provide materials, and give assignments to their students. It is often interesting for them to know how students visit these course websites and what pages are typically accessed together, this kind of information can help them better organize their classes.

In this paper, we present a new efficient association mining algorithm and apply it to the problem of web access association mining. Our approach can be divided into 3 steps: 1) web log cleaner: transforms raw web access log to a relational table; 2) transaction generator: converts the relational table to a collection of user access transactions; 3) association miner: mines the most interesting associations from the collection of web access transactions. The first two steps are mainly data preparation procedures, which are similar to those presented in some other papers such as in (Mobasher et al. 96). However, in these two steps, we also introduce some practical means to help users prepare data based on their interests so that only relevant access records and transactions are considered in the association mining procedure. The third step is accomplished by a new efficient association mining algorithm MFA (Most Frequent Associations). MFA is an extension of our previous work (Shen et al. 98) and the famous Apriori (Agrawal et al. 96) algorithm, which is used by most of current web access association mining systems (e.g., Garofalakis et al. 1999, Mobasher et al. 1996). By avoiding an exponential running time bottleneck as well as using the minimum support constraint, MFA has a better performance than (Shen et al. 98) and Apriori.

The rest of the paper is organized as follows. We describe our web log cleaner in Section 2, transaction generator in Section 3, and association mining algorithm in Section 4. We do a performance study in Section 5 and conclude the paper in Section 6.

Web Log Cleaner

Since the format of the collected web log data is not suited for direct import into the mining algorithms, it is important to transform and clean this data. The web mining system we are developing includes components for finding classification and association patterns. Because of this we first transform the raw data to a relational table, a suitable format for doing classification. Our transaction generator will later convert the relational table to a collection of access transactions for mining associations.

To convert the raw web logs into a relational table, we introduce a schema file. The function of the schema file is to tell the web log cleaner both the formats of the raw data and of our target relational table. The schema file can be defined flexibly to meet the different requirements in different situations. For example, web servers may have different log formats, and users may have different interests in access record attributes.

In our experiments, we use as test data the web logs in the computer science department at Dartmouth. Our access logs are generated by the logging module of Apache 1.3.6, which is an extension of Common Log Format. Please refer to http://www.apache.org/docs/mod/mod_log_config.html for detailed log format information. We extract the following attributes to form our relational table: Host, Day, Month, Year, Time, Method, Location, Bytes; where Host is the domain name or IP address of the request, Day/Month/Year/Time is the time stamp of the request, Method is the method of request (GET or POST), Location is the name of the file requested, and Bytes is the size of the data sent back.

In our schema file, we also provide effective mechanisms for users to generate a customized relational table based on their interests. These mechanisms work only for categorical attributes (coming from an unordered domain), not for numeric attributes (coming from an ordered domain). Given a categorical attribute, users can define a set of strings of the following two types: 1) significant string x: the relational table includes only records with the corresponding attribute value that contains x. 2) negligible string y: the relational table includes only records with the corresponding attribute value that does not contain y. For attribute "Location", users can define several group strings, say "*.z", such that all files with name matching "*.z" will be treated as one group value only.

Thus, using significant string ".edu" for Host, users can generate all access records which are coming from educational institutions. Using negligible string ".gif" for Location, users can exclude all access records targeting any GIF file. This is very useful, since users usually want to filter out unwanted entries like accesses to image files that were embedded in a web page whose 'hit' had already been logged. Also, using (for example) group string ".pdf" for Location, users can group all PDF files to a single group value. This restriction is especially useful for association mining, since downloading lots of PDF files often form large transactions, which is not only unnecessary but also bad for the performance of association mining algorithms. In short, these restrictions can help users focus on their interests and improve the quality of mining results, and can also help improve the performance of the mining algorithms.

Transaction Generator

To apply association mining algorithms to web log mining, one needs to work on a collection of transactions. Unlike market basket analysis, where a single transaction is defined naturally, we do not have a natural definition of web association transactions. Since we are interested in finding pages that are often visited together, a transaction should consist of a set of Locations (i.e., requested files). We define a transaction based on the set of all log entries belonging to the same host (domain name or IP address), within a given time interval (provided by the user; we use 1 hour in our experiments) (Mobasher et al. 96). Our transaction generator scans over the relational table obtained in the step 1 and generates a collection of access transactions, each of which is a group of locations belonging to the same host within a given maximum time gap.

To help users focus on interesting access transactions, we provide them with two parameters: minTranSize and maxTranSize. A transaction with size between minTranSize and maxTranSize is considered to be a transaction of good size. The output of our transaction generator includes only transactions of good size. By setting, for example, minTranSize to 2, users can focus on all transactions containing at least two locations, since associations can only happen between at least two locations and some users may regard all singleton transactions as uninteresting. Another example of using the parameters can be found in an E-Commerce application. In an on-line shop website scenario, it is natural for the analyzer to distinguish between serious access transactions and occasional tourist access transactions based on the number of hits included in the access session. It is also valuable to find the different access associations between these two types of access transactions. Our mechanism can help approach this goal, if, for example, we choose to view serious transactions as those with size above 10 and occasional tourist transactions as those with size below 10.

Mining the Most Frequent Itemsets

After finishing the data preparation for a collection of access transactions, we focus on our association mining task. As we mentioned before, an association rule has the form X => Y, where X and Y are sets of items or itemsets. The association rules problem is that of computing all association rules that satisfy user-specified minimum support (MinSup) and minimum confidence (MinConf) constraints. The problem can be divided into two subproblems: 1) finding all frequent itemsets (that is, itemsets that satisfy MinSup); and 2) finding all strong rules (that is, rules that satisfy MinConf) from all frequent itemsets. The second subproblem is relatively straightforward. The following is a naïve but feasible algorithm: for each frequent itemset a and each subset b of a, if support(a)/support(b) >= MinConf, then output b => (a - b). Almost all previous studies focus on the first subproblem: computing frequent itemsets. Among them, the Apriori algorithm (Agrawal et al. 96) is the most popular one, which is why we do experimental comparison between our approach and Apriori in Section 5.

Based on the above problem definition, we observe that an inappropriate MinSup may imply an exponential number of frequent itemsets and cause any solution to have an exponential running time. In practice, users sometimes have no easy control on setting MinSup and may run into this exponential bottleneck. Note that it is much easier to say "top 100" and "top 1000" than set MinSup. Based on this, we introduce an interesting new problem by adding a new result size constraint N: the desired number of frequent itemsets. In (Shen et al. 98), we have presented an algorithm for mining the N most frequent itemsets without considering MinSup. The algorithm has good theoritical performance, i.e., running in polynomial time (in terms of N) for practical applications. However, due to lack of MinSup constraint, it may run more slowly than Apriori in practice when N is large and

MinSup is high. Also, if N is set too small, most of the frequent itemsets generated are 1-itemsets, from which interesting association rules cannot be derived.

We have derived an efficient algorithm, MFA (Most Frequent Associations), to remove the above disadvantages by mining the top N most frequent itemsets (with size>1) satisfying MinSup constraint. Its advantages are: 1) as an extension to (Shen et al. 98), theoretically it runs in polynomial time for practical applications (see (Shen et al. 98) for a proof); 2) using both N and MinSup as constraints, it has better performance than Apriori and (Shen et al. 98); 3) it uses N constraint only for counting the number of frequent itemsets with size>1 so that enough association rules can usually be guaranteed to be obtained.

MFA computes frequent itemsets in passes. At pass k, MFA finds the N most frequent itemsets with size >1 and satisfying MinSup (called k-winners) among U_k, the set of all itemsets of size<=k. MFA uses W_k to store all k-winners, and uses k-CriSup to denote the support of the most infrequent k-winner. W_k is used to generate C_{k+1}, the candidate itemsets for whom support is counted in the (k+1)-th pass. The key idea is that an itemset can be pruned from C_{k+1} if any of its k-subsets does not belong to W_k because of the following reason: we have k-CriSup<=(k+1)-CriSup, since the candidates competing for (k+1)-winners form a superset of the candidates competing for k-winners; thus, given any (k+1)-itemset, say x, it satisfies (k+1)-CriSup and so satisfies also k-CriSup, which implies that any k-subset of x must be a k-winner. MFA terminates either when k reaches the total number of items or when C_k is empty.

Performance Study

We have implemented our web association mining approach in our web mining system and done an experimental study on both real web access logs and synthetic data sets. We present some of our experimental results here. Our system is written by C and the experiments on real web access logs were done on an SGI with 128 MB memory running IRIX 6.5. The experiments on synthetic data were done on a DEC Alpha 500/333 with 512 MB memory running Digital UNIX V4.0F. We measure performance by looking at, (1) for real web logs, if our approach can find interesting results within reasonable amount of time, and (2) for synthetic data, if our approach runs faster than previous algorithms and has good scalability.

Tests on Real Web Logs

In this test, we try to find if our approach can efficiently find interesting patterns from a large number of real web access log entries. We have collected 3 months (from 9/12/99 to 12/12/99, roughly the Dartmouth College's 1999 Fall Term) web access logs from our department's web server, consisting of 3559272 entries. In the experiments, we use negligible strings ".gif", ".jpg", and ".xbm" to ignore these image files, and group strings ".pdf", ".ps" and ".bib" to group related files to the corresponding group values. We always set MinSup count (referring to the number of transactions) to 20, result set size N to 200, and MinConf to 50%.

We use minTranSize.maxTranSize.range to denote the mining task we performed, where range can be one of {all, cs5, cs88}, 'all' denotes no significant string constraint, 'cs5' and 'cs88' denote using "~cs5" and "~cs88" (referring to two Dartmouth class accounts) as significant string constraints, respectively. For example, '2.30.cs5' denotes the mining task which focuses on all access transactions with size between 2 and 30, where the involved access records are all from accesses to cs5 class website. Table 1 summaries test results on 6 mining tasks, where we uses these parameters - goodTnum: the number of transactions in good size; prepTime: the total running time of step 1 and step 2; miningTime: the running time of step 3; AssoN: the number of final winners (i.e., frequent itemsets) with size>1; RuleN: the number of strong rules extracted from frequent itemsets.

Task	goodTnum	prepTime	miningTime	AssoN	RuleN
1.100.all	419384	1431.04	357.91	200	488
2.30.all	182753	1437.5	518.08	200	587
1.100.cs5	12135	518.93	2.87	200	327
2.30.cs5	10632	521.72	2.15	200	333
1.100.cs88	774	496.76	0.13	67	67
2.30.cs88	591	495.07	0.12	64	78

Table 1: Test results on 6 mining tasks.

From Table 1 we see that all these mining tasks produce a suitable number of interesting patterns within reasonable amounts of time. We also find that the good transaction size setting affects more the performance of the mining algorithm rather than the performance of the data preparation phase; e.g., refer to tasks 1.100.all and 2.30.all. In addition, for tasks 1.100.cs88 and 2.30.cs88, the number of frequent itemsets are decided by MinSup instead of N, since MinSup is too high to include N winners in this case.

The following are two examples of interesting rules found.

1) In task 1.100.all, we found a frequent itemset {/SOSP99/, /SOSP99/program.html} supported by 1555 accesses. This itemset can generate only one rule "/SOSP99/program.html => /SOSP99/" with confidence 76.34%. From this, we can conclude that people who visit the program page for the SOSP99 conference tend to also visit the homepage of the conference; however, this is not true in the reverse order.

2) In task 1.100.cs5, we found a frequent itemset {/~cs5/, /~cs/syllabus.html} supported by 4161 visits. This itemset can generate two rules: "/~cs/syllabus.html => /~cs5/", with confidence 90.46%, and "/~cs5/ => /~cs/syllabus.html", with confidence 50.66. We can see that the homepage and the syllabus page of the cs5 class are often visited together. The professor can use this kind of patterns to find out how students use the course website materials.

Further research on performance using the real logs is on-going. Some interesting topics here include further tests on real logs from commercial web sites, studying differences between rules generated by using different transaction size settings, and customizing the result rule sets to focus on truly interesting rules.

Tests on Synthetic Data Sets

To assess the performance of our mining algorithm, we use synthetic datasets publicly available from IBM Quest Project Website (Agrawal et al. 96), since our web logs are not large enough to generate a truly large set of transactions. We use the notation Tx.Iy to denote a dataset in which x is the average transaction size and y is the average size of a maximal potentially frequent itemset (see (Agrawal et al. 96) for more details on the dataset generation). To keep the comparison fair, we implemented all the algorithms using the same basic data structure.

Figure 2 shows the performance comparison between MFA, (Shen et al. 98) and Apriori. We use a test data set T20.I6 that includes 100K transactions to do the test. Time(s)-axis refers to the running time in seconds, N-axis to the result size constraint, and MinSup-axis to the MinSup constraint. Tests performed using Apriori and (Shen et al. 98) are shown with some values of "N/A", since Apriori does not need a result size constraint N and (Shen et al. 98) does not use the MinSup constraint. All the other tests are performed by using MFA and each has specific N and MinSup constraints. The left part of the figure shows that when MinSup constraint becomes low, Apriori tends to run into its exponential bottleneck, and both MFA and (Shen et al. 98) do not have this performance bottleneck. The right part shows the comparison of MFA and (Shen et al. 98) in a larger scale by removing Apriori test results and from there we can see that MFA performs better than (Shen et al. 98).

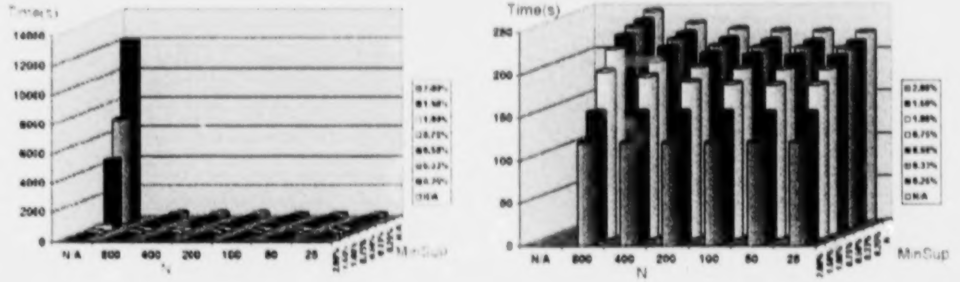

Figure 2: Performance comparison among MFA, (Shen et al. 98), and Apriori.

Figure 3 shows the scale-up performance of MFA. The left part shows the results by scaling up the result size constraint N, where we set MinSup=0.25% and use two data sets, T10.I4 and T20.I6, both containing 100K transactions. The right part shows the results by scaling up the number of items ('I' denotes the set of all involved items), where we also set N=200 and MinSup=0.25%, and use the same data sets as above. The middle part shows the results by scaling up in the size of database D, where we set N=200 and MinSup=0.25% and use two groups, T10.I4 and T20.I6, of datasets with sizes (numbers of transactions) from 100K to 1M. These results show that our algorithm has good scale-up performance in terms of these 3 parameters.

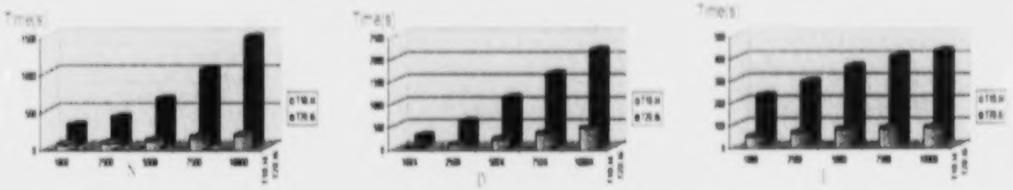

Figure 3: Scaleup Performances in terms of N (result size), |D| (database size), and |I| (number of all items).

Conclusion

This paper introduced a framework for extracting web access association patterns that are defined to be interesting by the user. We have implemented the framework in our web access pattern mining system and have evaluated this approach using both synthetic data and real web logs. Our results have shown the efficacy, efficiency and good scalability of this new mining approach. The research and development of our web log mining system are on-going. Some interesting future topics include 1) creating a data warehouse like (Joshi et al. 99) to better organize the cleaned access records and extracted mining results, and to enhance users' flexilibity for accomplishing more meaningful mining tasks; 2) building a better interactive user interface and developing effective visualization tools for presenting mining results in a vivid way; 3) testing on real commercial web log data and finding new problems; and 4) developing and incorporating additional data mining and web mining techniques.

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Nine Keys to a Knowledge Infrastructure: A Proposed Analytic Framework for Organizational Knowledge Management

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Abstract: The last decade has seen a flood of both theoretical work and practical hands-on efforts in KM. In an effort to bridge theory and practice, this paper proposes one analytic framework for organizations to plan, implement, and evaluate their knowledge management activities. The framework – the nine keys to a knowledge infrastructure – is designed to be simple enough to work with, and at the same time, powerful enough to generate insights that will lead to productive action. The paper begins by positioning the framework amidst the concepts of "Organizational Vision," "Knowledge Organization," "Knowledge Management," and "Knowledge Infrastructure." Then it presents nine keys to a knowledge infrastructure: *culture, technology, processes, users, switchboard, services, value, design, premises*. The keys are divided vertically into three phases of knowledge management and horizontally into three centers of focus. The paper concludes with a reflection on the uses of the framework and a call for comments about it.

Introduction

More and more organizations, small and large, local and global, for profit and not-for profit, are waking up to the need for knowledge management (KM), and as a result, the KM market, with its assorted consultants, experts, technologies, and applications, is expanding rapidly.

Individuals and organizations have been practicing knowledge management for ages: the cave dwellers learned how to adapt to their environment; nations mastered their strongest methods of combat; farmers discovered how to work the land to their best advantage; women have long understood their reproductive cycles. The examples are as various as the methods; some are automatic, almost instinctive, while others are consciously learned and applied.

Modern knowledge management is more than merely document organization, decision supporting systems, artificial intelligence, re-engineering core processes, and many new age "e"-terms. Knowledge management is based on awareness of the inherent nature – good and bad – of knowledge (Davenport & Prusak, 1998). Indeed, every knowledge management effort must start from the assumption that there is good and bad in knowing and good and bad in not knowing.

The current tidal wave of knowledge management stems from three related factors:

1. First, **is the need**. The knowledge environment is evolving more rapidly than it ever has. There is so much data, information, and knowledge, and so many databases and other resources, and all of it is more accessible than before.
2. Second, **is the recognition of the need**. Upper management has come to recognize knowledge as a primary strategic asset, and hence the formal, organized push to further and capitalize on that knowledge.
3. Third, **is the ability to do something about the need**. Accelerated, powerful tools can meet the need. Innovations in computing, networking, and knowledge circulation in the workplace are all part of what now makes knowledge management a doable effort.

This paper does not describe a particular KM solution, nor does it offer a blueprint for how to "do" knowledge management. Rather, my goal is to present an analytic framework to understand the elements of bringing KM into an organization effectively. These elements, or "keys" as they are called here, form the basis for KM communication, analysis, and decision-making.

Like any framework, the nine keys framework has limitations stemming from the nature of analytic frameworks. For example, a geographical map, a common framework to represent terrain, will highlight certain features of the terrain, but it may also distort some of the terrain's features. A blue line on a map may mark a river that in fact is dry, or whose water is not blue. In the same way that capturing the true color of every river is not possible, so too capturing the actual meaning of each knowledge infrastructure key in the real world is not feasible.

The lesson that emerges is that certain parts of a framework may look quite different in the real world. Just as a map is only a map, not actual terrain (Kent, 1978), so the framework proposed here may offer keys more relevant to one particular situation over another. One key may be a critical one, another less so; a particular key in your setting may not present any problem or demand analysis.

Positioning the Nine Keys

To fulfill the
Organizational Vision

the organization needs to be a
Knowledge Organization

by practicing
Knowledge Management

which is based on a
Knowledge Infrastructure

which, in turn, can be continuously planned, implemented and evaluated using
an analytic framework like
Nine Keys to a Knowledge Infrastructure

Figure 1: A Strategic Perspective on a Knowledge Infrastructure

Before a bridge is built, its building site must be identified. Similarly, before the nine keys are presented, certain background terms must be defined and explored. The following discussion is intended to map the relative position of the nine keys framework within the setting of organizational life.

First, an overview. An *organization's vision* is to realize its potential. Often, success is contingent on whether the organization is a *knowledge organization*. An organization becomes a knowledge organization through practicing organizational *knowledge management*, which is based on a *knowledge infrastructure* (see Fig. 1).

Organizational vision has to do with the organization's strategy, its core competences and core rigidities, its market and its competitors. Being a knowledge organization is different from having an organizational vision.

A *knowledge organization* is an organization that recognizes knowledge as a critical strategic asset and equips itself with the requisite tools to use its knowledge. Often faced with rapidly-changing market conditions, new players, and increasingly sophisticated and demanding consumers, organizations now find that not only is the competition fiercer, but even more important, the pace of today's business world is faster than ever before (Davis & Meyer, 1998). Speed and accuracy are critical to an organization's vitality, and they come largely from an organization's ability to exploit its available internal knowledge and glean whatever knowledge it needs from outside sources (Tobin, 1998; Allee, 1997).

What exactly then is *knowledge management*? Knowledge management can be many things to many people, all centering on such actions as canvassing, storing, and using knowledge. Professionally, the field of knowledge management has been defined in a variety of ways, ranging from clear, denotative statements to connotative and somewhat obscure definitions (for example, Prusak, 1997, pp. 229-30; Newman, 1991; Ruggles, 1997, p. 1).

My working definition is as follows: *Knowledge management is the art of gathering, sharing, disseminating, and using knowledge atoms such as data, information, experiences, evaluations, insights, wisdom, initiatives.* In other words, KM is the applications of various knowledge actions on different knowledge objects.

An organization manages its knowledge through a *knowledge infrastructure*. A modern knowledge infrastructure connects different organizational members to different sources of internal and external knowledge. Typical examples include formal knowledge interactions – libraries, the monthly CEO letter, employee manuals, standard operating procedures (SOP), e-mail systems and intranets – as well as informal knowledge interactions – the famous cooler, the whiteboard, random meetings, methods of feedback, and the like. In its full-fledged form, a knowledge infrastructure is one of the organization's core competencies, functioning almost like a nervous system that links the other core tools. A strong knowledge infrastructure necessarily strengthens the capabilities of the organization; conversely, without it, an organization functions at diminished capacity.

The Framework: Nine Keys to a Knowledge Infrastructure

The nine keys are in a sense an expansion on the term "knowledge infrastructure." When people ask what we need in order to manage knowledge, the quick answer is that we need a knowledge infrastructure. When asked, "say some more about this," then one could use the nine keys, stating that a good, solid, sustainable knowledge infrastructure allows the organization to plan, implement, and evaluate its knowledge management activities.

Phase1 **Plan the Foundations**	*Phase 2* **Implement the Systems**	*Phase 3* **Evaluate the Outcomes**	
Key 1 **Culture**	*Key 4* **Users**	*Key 7* **Value**	**➔ Individual Focus**
Key 2 **Technology**	*Key 5* **Switchboard**	*Key 8* **Design**	**➔ Contextual Focus**
Key 3 **Processes**	*Key 6* **Services**	*Key 9* **Premises**	**➔ Organizational Focus**

Figure 2: Nine Keys to a Knowledge Infrastructure

The nine keys framework (Fig. 2) is a 3 x 3 framework, meaning, that its components take on a dual significance when considered according to their phases (the vertical columns) and according to their centers of focus (the horizontal rows). Each key is an integral part of the overall combination: note that no one key is dominant over another, although each is specifically placed in the framework.

The Three Phases

As with any infrastructure building, the first phase is a planning one, in which those leading the KM initiative lay necessary foundations. This first phase leads to the second phase, the actual building or implementing of the systems. With the systems in place, the organization is then ready for phase 3, evaluating, which in turn leads to modifying plans and refining systems to meet the organization's needs better (Fig. 3).

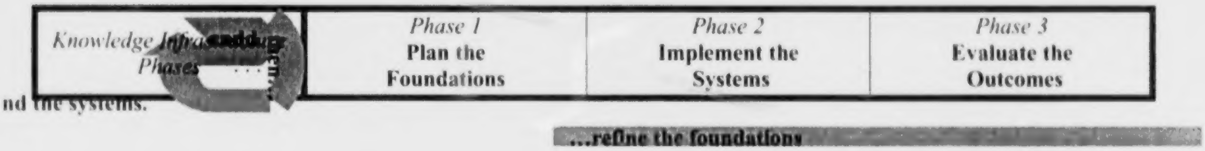

Figure 3: Three Phases of a Knowledge Infrastructure

Phase 1: Plan the Foundations of Culture, Technology and Processes

A knowledge infrastructure is built on three complementary foundations. Integrating foundations of *culture*, *technology*, and *processes* is the necessary condition for any knowledge infrastructure.

The first foundation is a *culture* of knowledge usage and knowledge sharing (Argyris, 1998). Before an organization can effectively practice knowledge management, it must embrace certain common assumptions. Among the knowledge concepts that belong to the culture key are:

- Shared knowledge is indispensable. In other words, the whole of an organization's knowledge is far greater than the sum of its parts.

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- Knowledge is not static, but lives by being cultivated through a revolving process of dissemination, use, and return.
- Knowledge management is a core business process, and as such it should have its own set of defined resources, goals, and monitoring systems.

Many more knowledge culture concepts will need to become part of the organizational culture, including cognitive overload, redundancy, need to know base, the value of partial knowledge, the value of lack of sharing, and more. All these assumptions form a theoretical consensus, a cultural view, on the need for knowledge management, and in turn encourage practices of knowledge management such as acquisition, usage, and exchange.

The second foundation is the knowledge *technology*. Managing knowledge only by trading pieces of paper or even trading e-mails is obsolete, not to mention inefficient. Paper, as well as paper folders, paper cabinets, and papers staplers, will be matched by their twins in informational technology, such as digital documents and document folders. When personal computers with built-in high-bandwidth networks can be bought for $250, a common knowledge technology foundation for the organization is feasible, which is perhaps the greatest qualitative departure from earlier systems of knowledge management.

Knowledge management technology has spread out over different dimensions of computers, networks, and other IT hardware, and KM-specific software. Most of the software now on the market attends to individual KM challenges, rather than resolving such challenges more comprehensively. As the KM market matures, more and more powerful KM software will be available. But for now, the organization needs to plan a basic hardware foundation that can adapt to assorted KM technologies.

Finally, there is a foundation of knowledge *processes*. With cultural and technological foundations in place, actual procedures can now be "knowledge-ized." Classical business practices may be viewed through a knowledge prism, so that what an organization does and how it acts are strategic decisions emanating from knowledge.

These are the three essential foundations that must be laid as part of the planning stage for building a knowledge infrastructure. To introduce knowledge management without adequate planning would be to sacrifice fundamentals to haste and enthusiasm.

Phase 2: Implement the Systems of Users, Switchboard, and Services

With the foundations in place, the organization is ready to implement its knowledge management operation. Overall, this operation is an active connection between three main components, *users* of the knowledge infrastructure who access knowledge *services* via a knowledge *switchboard* (Fig.4).

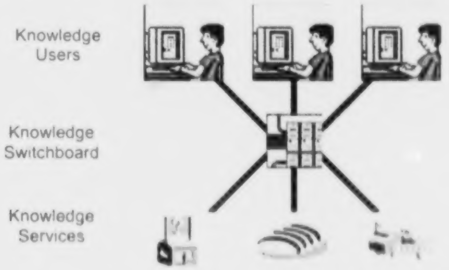

Figure 4: The Architecture of the Infrastructure Systems

The knowledge *users* are the people, machines, or systems that will practice knowledge management. Extending beyond organizational workers, knowledge users include clients, suppliers, and other contributing entities. Recruiting users, encouraging them, and supporting them during the knowledge process is a main focus of the organization, because knowledge management ultimately depends largely on the extent to which the system is used. Knowledge usage refers to one or more actions, such as gathering, selecting, updating, trading, and contributing knowledge to one or more knowledge objects. Users must understand which type of action to perform and when, and how to impart the knowledge they attain.

The knowledge *switchboard* is the technical mechanism that implements user functions. A "transparent" black box, that is, transparent to the user, it must be secure, powerful, and "user-friendly." In effect, it must respond to and perform users' knowledge actions without users feeling its weight or being burdened by it. As the interface between users and knowledge services, this interface needs to present as an inviting, comprehensible interface that offers a standard look and feel for the knowledge units, and has built-in evaluation capacities to measure the effectiveness and use of the system.

The switchboard links the knowledge users to the knowledge units, called here knowledge *services*. The goal of the services mirrors the overriding goal of the knowledge infrastructure, namely, to make knowledge more useful. The concept of a knowledge service is familiar from "service" in other contexts, that is, doing something for someone else. The knowledge service both houses the knowledge that users will need, and also affords the context for the various knowledge user functions such as add, sort, view, update, and delete. By their nature, knowledge services are dynamic: they evolve, expand, and dissipate according to changing user and organizational needs.

This second phase of implementing the systems is the actual building of the knowledge management system itself. The infrastructure begins on a limited scale and eventually expands, encompassing more users and services. From this point on, the system grows according to need, expectation, and evaluation, which is the subject of the third phase.

Phase 3: Evaluate the Outcomes of Value, Design, and Premises

One essential feature of a good knowledge management system is the built-in evaluation capacities. Crucial to the success of the knowledge management efforts is proof of its use and of its effectiveness – in other words, evidence of its own viability as an organizational tool. Far from a luxury, the evaluation capacity is a crucial knowledge-supplying source about the knowledge management system. Evaluation demonstrates the *value* of the knowledge services, impacts on the re-*designing* of the knowledge infrastructure, and ultimately influences organizational *premises*.

The first mode of evaluation is *value*, or in familiar corporate terms, Return on Investment (ROI) that is both financial and non-financial (Phillips, 1997). Knowledge services are created in specific ways so that their use will enhance both the organization as a whole and the individual members of the organization. This dual purpose of a knowledge infrastructure is critical, because an organization whose employees are intent on advancing themselves improves its chances of success. Every dollar invested in a powerful knowledge infrastructure contributes to savings, efficiency, and enabling, and in this way enhances both the organization and its members (Sivan, 1999).

The second mode of the evaluation is more formative, and refers to *design* of the knowledge infrastructure as a whole and the specific knowledge services as its parts. Evaluation and feedback are constant spurs to question the efficacy of the services, and with the knowledge they generate, the re-designing of services may be indicated. If a service houses too much knowledge, for example, without sufficient breakdown into smaller, more accessible units, this configuration needs to be corrected. If the service was introduced before users required it, it may need to be removed, at least temporarily. Such questions about the design of the services form a critical key to the ongoing success of the infrastructure.

In the third, reflective mode, evaluation becomes a means to examine the organization's *premises*, from tacit assumptions to operational strategies (Myers, 1996). Knowledge that emerges from the infrastructure can impact fundamentally on an organization's basic decisions, strategies, and priorities. Knowledge is used, re-used, re-directed, and re-purposed in order to advance both tactical and strategic visions.

The *premises* key holds the greatest value for the organization. It embodies the potential for change. Knowledge services, users, and technologies change, and a good infrastructure will accept change easily. Indeed, the goal of a knowledge infrastructure is to make available knowledge usable, and the best method for the long term is a sustainable system - a system that can expand and mold itself to an organization's changing knowledge needs.

This first sketch examines the nine keys to a knowledge infrastructure. These are all integral elements, contributing in different but complementary ways. Although I have presented these phases as chronologically consecutive, they are not quite as distinct and static as the chart suggests. Particularly the evaluation phase is one that sparks new planning and new implementation: those responsible for KM in the organization use their infrastructure-generated knowledge to improve and sharpen the system.

Re-Viewing the Interlocking Nine Keys through Focus

As I mentioned earlier, there is an additional approach to the framework: each linear level of the three consecutive phases constitutes a distinct knowledge infrastructure focus. In the top row, all the keys deal with the *individual focus* of the knowledge infrastructure. Knowledge culture is a function of people: a culture is created and promoted by the individuals who are part of the organizational system. Clearly the knowledge users also belong to this category, as does the key of value (in the evaluation phase), which measures how much individuals, on an organizational and personal level, are the focus of the knowledge infrastructure.

The second focus is the *contextual focus*, or the ecology of knowledge management. Any contemporary form of knowledge management is based on technology, and which technology environment will be chosen and created is determined in the planning stage. The particular switchboard, along with other specific KM interfacing tools, is implemented in the second phase, while the formative design of the third phase evaluates and questions the effectiveness of the basic knowledge tools. Together, these three keys form the context, or the technological setting, of the knowledge infrastructure.

The bottom row is concerned with the *organizational focus*. The processes that the organization follows, the type of knowledge it acquires and disseminates, and the reflective use of knowledge all comprise the central nexus of the organization. Taken together, the people, the organization, and the interface between them are what create the knowledge management system.

Epilogue: How to Use the Keys

What remains here is to consider the uses of the framework. The interested reader may re-examine ways the framework of nine keys to a knowledge infrastructure can be applied. The keys can sharpen an analysis of the current state of knowledge management, or on a more limited scale, an analysis of a particular knowledge management initiative or an assessment of a particular knowledge system. Such potential uses only hint at the overall generative power of the framework.

Both experts and newcomers to knowledge management can use the framework. Novice users can use it as an analytic checklist, in which the keys prompt analytic KM questions. Expert users, more familiar with the ins and outs of knowledge management, may use the matrices of two or three interlocking keys to analyze an issue.

Is this the only framework for a knowledge infrastructure? Absolutely not. Moreover, the framework must be modified and refined to support the evolving demands and circumstances of the knowledge age. Yet if the framework succeeds in sparking new ideas about the components of a knowledge infrastructure, it contributes to an understanding of the challenges and rewards of knowledge management.

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Enabling Conditions for Organisational Knowledge Creation

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Abstract: Intranet tools for knowledge management are becoming increasingly popular. In this paper, I argue that intranets are indeed particularly suitable for supporting and facilitating corporate creativity and the knowledge creation process. Building on existing literature, I explain the mechanisms involved in creativity and identify eight enabling conditions. I further show how and when the characteristics of an intranet facilitate those conditions. An important factor that seems to fall outside the scope of IT however is the role of motivation.

Introduction

Research has shown that an intranet can play an important role in various Knowledge Management (KM) efforts, facilitating activities such as "smart" information retrieval, sharing of tacit knowledge, community building, and creative brainstorming (Stenmark 1999a, 1999b, 2000). The theoretical basis for empirically informed work such as those referred to above has however been fragmented and unclear and no coherent structure on which to build future research has yet been presented. In this argumentative paper, I draw on the existing literature on corporate creativity and knowledge creation, in particular the works of Robinson and Stern (1998), Amabile *et al.* (1996), Bawden (1986), and Nonaka and Takeuchi (1994), to provide such a theoretical foundation. This base will help us understand what conditions affect knowledge creation and how creativity may be supported in a corporate context.

Though these conditions have implications on many different levels, cultural, managerial, and social, this article concentrates solely on the technological aspects. Having introduced the enabling conditions in section 2, I therefore spend section 3 elaborating on the characteristics of Internet technology and argue in section 4 that an intranet is particularly well suited to facilitate corporate knowledge creation.

Key Conditions for Creativity

One very distinctive aspect of creativity is that it tends to show up when and where it is least expected. Creativity incorporates a large element of surprise and most creative acts are totally unplanned. In fact, both the opportunity to innovate and the source of innovation are uncertain and unpredictable (Kanter 1988). However unpredictable creativity may be, it can still be promoted. Though *what* the creative act will be cannot be predicted, the likelihood that it will take place may be increased by the presence of a set of enabling conditions. Managing creativity is thus about raising the probability for creative acts to happen by stimulating the conditions that work in favour of creativity. In this article, I claim that there are eight such enabling conditions or factors.

1. The no-preconception principle

As stated above, it is impossible to know in advance who will be involved in a creative act, what the act will be, when it will take place, or how it will occur. This principle is fundamental to creativity and not being able to appreciate it may result in unnecessary limitations to creativity. In their report on corporate creativity, Robinson and Stern (1998) refer to this condition as the "no-preconceptions principle". The authors present numerous examples of how violation of this principle have hampered creativity, e.g. by appointing teams of "creative" workers while excluding others equally likely to be creative (predicting *who*), by trying to control and steer the result of creativity (predicting *what*), or by establishing quotas for how many creative ideas to produce per month (predicting *when*).

2. Self-Initiated Activities

Planned actions can only take an organisation in directions already anticipated. To reach the unexpected, the company must put their trust in the unplanned actions that are often the result of user initiatives. Since corporate settings with deadlines and resource constraints do not allow for spontaneous self-initiated activities, some actions on the corporate behalf are required to set free the desire to initiate creative acts. The expression "Skunk Works" was coined during the second World War by the aircraft manufacturer Lockheed Martins to describe a situation where a small group of technicians were allowed to work outside the established bureaucracy and with minimal management control. It has been shown that low formalisation and large degrees of freedom aid creativity and innovation, especially during the initial stages (Kanter 1988). To allow such user initiatives correlates to what Nonaka and Takeuchi (1994) refer to as autonomy – the freedom for individuals to act on unexpected opportunities. Robinson and Stern (1998) observe that creativity often requires extraordinary dedication and that most employees would willingly do far more than the company could possibly ask of them if only they were allowed to work with things to which they were committed. The company should therefore allow, and encourage, as much autonomous, self-initiated, and unofficial work as it can.

3. Serendipity

An accident can only result in a useful invention if someone is able to recognise its potential. Thus, a particularly important point in regard to chance is the preparedness that comes from being informed. The more information that has been assimilated, the more likely it is that a happy accident will be utilised. The information does not however, have to be restricted to facts closely related to the problem or task at hand. On the contrary, information apparently unrelated to the problem seems to be particularly important for major conceptual breakthroughs (Bawden 1983, Nonaka & Takeuchi 1994).

Different steps may be taken to stimulate and promote serendipity. Firstly, the frequencies with which potentially fortunate accidents can happen can be increased by encourage tinkering, experiments, and empirical research not as separate events but blended into the ordinary work. By experimenting in the real world and interacting in the running processes, people expose themselves to situations where fortunate accidents are likely to occur. Secondly, serendipitous events happen more often than most people realise and it is important that the accidents that do happen are noticed. By paying attention to the unexpected, noticing exceptions to accepted schemes, and examining inconsistencies within established theories, we may detect fortunate accidents (Robinson & Stern 1998; Bawden 1983). Thirdly, the preparedness must be increased. By actively creating an unused potential for change, the organisation may move beyond the predetermined mindset that comes from only pursuing what is needed for the current task. This can be achieved by having the employees take classes or attend conferences not related to their work or encouraging job rotation across functions.

4. Diverse Stimuli

It is impossible to tell in advance what stimuli will spark an innovative idea since what stimulates one person may not even be noticeable to another. Trying to push stimuli to the employees will therefore only have a limited effect on creativity. Though taking off-target courses may increase serendipity, it does not necessarily provide the stimulus needed to set of creativity. The organisation should instead help its members to get stimuli while doing their ordinary work, and facilitate the sharing of such stimuli. Such cross-fertilising processes sometimes referred to as "kaleidoscopic thinking" (Kanter 1988) may be achieved by allowing cross-functional meetings, customer contacts, visitors, and other activities that exposes the employees to new input.

Bawden (1986) warns for the potential danger of false knowledge, in particular the it-is-known-to-be-impossible kind, which by numerous commentators is seen as having prevented or postponed otherwise successful experiments and important break-throughs. However, false or out-dated knowledge may also be seen as yet another stimulus. When used as a spark for imaginative thinking it does not matter whether the information or knowledge is true or false. It is the outcome of the process that should be evaluated – not the input.

5. Intra-Corporate Communication

Creative acts often happen as the result of the bringing together of actors or component from unexpected places. Traditionally, corporate communication channels were implemented to promote vertical information sharing. If only such official channels are used, people in different parts of the organisation will never interact. Though a company's creative potential increases with size, larger organisations automatically mean longer distances between people. Without efficient ways for the members to communicate across department boundaries, there is an obvious risk that the benefits of size are lost (Robinson & Stern 1998). The company should therefore more actively support activities and create places where employees that do not normally work together can meet informally and share stimuli and ideas. By being aware of ongoing activities each employee gains sufficient understanding of the capacity of the organisation and is able to tap into the organisation's resources.

6. Trust and Reciprocity

Many commentators have argued that co-operation cannot be achieved without the establishing of personal relationships, preferably face to face. von Krogh (1998) introduces the notion of *care*, encompassing readiness to help, lenience to judgement, and that effective knowledge creation requires a change of perspective from self-commitment to other-commitment. To achieve this level of trust and openness, management must explicitly state these values as prioritised.

However, as noted by von Hippel (1988), informal knowledge trading often occurs between companies – sometimes even between direct competitors. Fundamental to such networks is the unspoken, but yet strong, obligation to return a favour. Axelrod (1984) has shown that trust and co-operation can be achieved and sustained not only between strangers but in fact also between enemies at war or between creatures unable to appreciate the consequences of their own behaviour. Fundamental to the establishing of trust is the principle of reciprocity and the likelihood of meeting - and recognising - the same individual again in the future. Thus, if the future is sufficiently important relative to the present, mutual co-operation can be established. Reciprocity can therefore act as a proxy for trust and enable co-operation and knowledge sharing in an otherwise competitive environment.

7. Motivation

Amabile *et al.* (1996) have during years of empirical work found overwhelming evidence that intrinsic motivation is what best drives creativity. Also Robinson and Stern (1998) report strong correlation between the use of intrinsic motivation and high participation in the improvement process. The use of extrinsic motivation such as rewards or bonuses tend to cause a focus on the reward rather than on the task at hand, and winning the reward becomes more important than finding the most creative solution. Self-initiated activities, as discussed above, are powerful because they are driven primarily by intrinsic motivation. When employees are allowed to, and in fact encouraged to, pick and pursuit their own projects, they are driven by their personal interests. Research in a corporate setting has shown that professional interests rather than espoused theory is what motivates people (Stenmark 2000).

8. Rich Information Provision

The role of information and information systems in creativity work deserves to be spelled out, since surprisingly little attention has been paid to the particular aspects of information provision for invention and knowledge creation. Having identified the most appropriate means of organising and retrieving information for knowledge creation, Bawden's (1986) use of the verb browsing is interesting. Browsing here means the unstructured reading of various sources of information in order to receive inspiration or accidentally run into new pieces of information. The concept of browsing, as presented here, relates well with the earlier discussion of serendipity.

In addition to browsing there is also a need for traditional information retrieval (IR) techniques however modified and improved. Bawden argues that while free-text searching is more useful to non-IR professionals, it has the drawbacks of being too imprecise, and he suggests that the future tools should be capable of combining free-text with more controlled searching, giving the end-user the best of both worlds. Though broad and imprecise information help create the redundancy that is so vital to creativity, it also increases the risk for information overload (Nonaka & Takeuchi 1995). This calls for a careful balancing act.

Characteristics of the World-Wide Web

The World-Wide Web (the web) is, as most people are now probably aware of, an internet-based distributed hypermedia system. Developed by Tim Berners-Lee it was meant to be "*a pool of human knowledge, which would allow collaborators in remote sites to share their ideas...*" (Berners-Lee *et al.* 1994). The combination of the Internet computer network with its open protocols and standards and the hypertext structure on top, has resulted in a seamless interface to information regardless of platforms. This integrating capacity that the web incorporates has led to the incredible popularisation of the Internet/intranet that we have witnessed over the last decade. The web differs in many aspects from the information systems that reigned prior to the 1990's. The characteristics that best describe the web in general are that it is hyperlinked, networked, and open. The intranet is in addition also organisational restricted. Let us examine these characteristics in more depth.

Hyperlinked

The ability to create hyperlinks to other resources is perhaps the most significant feature of the web and something that allows it to transcend printed media. The hyperlink feature provides the users with extremely easy access to a huge amount of information, available at their fingertips. Any object anywhere in the web may easily be addressed and thus likewise easily accessed. The hyperlinks also allow individual users to create their own collections of useful resources.

The web is entirely user-driven, meaning that the users must actively search for or browse to the information desired. The user may visit sites and pages in any desired order, and interact with scripts and forms as he or she chooses. Users may also create new web pages, reorganising existing information by providing their own collection of links and texts. The web is by orders of magnitude the media with the highest ratio of production-access to audience-access. Nowhere else can so many people reach so many other people with such ease.

Networked

The web is obviously highly networked. The client/server architecture and the Uniform Resource Locator (URL) allow information to be placed anywhere in the network and the web is designed to make physical whereabouts of data transparent to the user. There is no central management or predefined hierarchy structure, meaning that anyone can publish. Web users are therefore not restricted to be simply information consumers, but may almost as easily be information providers, publishing whatever they have to share. The web, being distributed and not relying on a single focal point, is always available.

Open

The web is a bottom-up technology based entirely on open and accessible standards arrived at by system of consensus. The access mechanism of the HTTP protocol also allows proprietary formats to be used without having to standardise. A web page does not restrict the type or the amount of information presented. The openness also guarantees adaptiveness and access to formats and types not yet available, which enables information richness. Unlike many other IS solutions, such as e.g. payroll systems, internet technology is multi-purpose. To function as a multi-purpose tool the web is not restricted to text only, but is instead very media-rich, allowing a variety of forms and formats including images as well as video and audio.

Unlike most other client/server models, the web does not require the installation of any proprietary products or protocols. A standard web browser and a TCP/IP connection are all that are needed. Information may then be displayed independently of network or server topology. The open standards and the availability of free-to-use software for both servers and clients paired with the relatively low training requirements also makes the web cheap to implement relative mainframe solutions or thick-client systems.

Organisational Restricted

Being a subset of the Internet intranets have all of the above characteristics. In addition, they contain only users from within the own company, thus providing a minimal level of coherence that is otherwise absent on the web. Users on an intranet may further be presumed to share certain objectives and subscribe to the same set of values and beliefs.

Merging Conditions for Creativity and Intranet Technology

I have now outlined the eight enabling conditions for creativity and the four most influential characteristics of the web. In this section I will pair the eight conditions introduced in section 2 with the characteristics of the web as discussed above to show how and where the intranet may provide and support corporate knowledge creation. The numbers in the list below corresponds to the eight enabling conditions, respectively.

1. The no-preconception principle. Since it cannot be known in advance who will be involved in a creative act, the non-preconception principle implies that stimuli in form of the broadest variety of information should be made available to all employees on a corporate-wide basis. Nonaka and Takeuchi (1994) also stress the importance of being interlinked with an information network. Due to its platform independence, relatively low start-up cost, and being separated from the outside world, a corporate intranet is a good candidate for such a network.

2. Self-initiated activities and unofficial work are not directly related to the use of web technology in the sense that web access in itself does not make people start activities. However, those who already *are* engaged in unofficial or self-initiated work may benefit greatly from the web as a rich provider of information and other stimuli.

3. Serendipity, and the chances of the "happy accident" occuring, can be increased with a tool such as an intranet. The hyperlink concept enables the sort of casual browsing that Bawden suggests give the user easy access to cross-disciplinary and seemingly unrelated information. However, traditional IR tools have focused on high precision and exact Boolean matching, thereby not allowing the degrees of freedom required for casual browsing. Recent evaluations of intranet retrieval tools and agent-based recommender systems have showed promising results in their ability to find related information without relying on exact keyword-matching (Stenmark 1999b).

4. Diverse stimuli. The at-your-fingertips accessibility of the intranet makes it an ideal source of diverse stimuli, peripheral activities, and speculative information. However, ideas and suggestions not currently supported either by experimental evidence or by theoretical frameworks are difficult to share using formal communication channels. An intranet-based forum dedicated to dissemination of embryo ideas and tentative solutions as outlined in (Stenmark 1999a) can offer a solution.

5. Intra-corporate communication. Since the intranet is shielded from the outside world, corporate communication can be shared more freely. Documents and reports from departments in remote geographical locations may be read as easily as the ones from the group next to you. People who may never meet in person due to physical distance may meet in virtual "team-rooms" and share thoughts and ideas electronically. Bawden predicted that future IT systems would help blur the boundaries between formal and informal communication by offering support for lateral or horizontal information systems such as email and teleconferencing. Such systems would be particularly interesting from a cross-disciplinary point of view. Since the web not only allows reading but also enables decentralised information posting, any user may publish information and thus simultaneously communicate both vertically and horizontally. When used on an intranet, the information published is often not categorised as either formal or informal – it is simply information made available to a large audience. Studies have shown how users with similar interests may use the intranet to find each other (Stenmark 2000).

6. Trust and reciprocity. On the net, text is not just a form of communication - it is also a means for self-presentation (Donath 1999). There is a great difference in how a seemingly stable domain address such as www.ibm.com and a seemingly ephemeral one such as 131.97.121.87 are experienced. As names in the real world, domain names, and indeed also user signatures, bring to mind many associations. The ability to recognise the other player from past interactions is necessary to sustain co-operation. On an intranet, where all players are known to be company employees and thus can be excepted to be around also in the (near) future, the incentive to engage in co-operation is higher than on Internet in general.

7. Intrinsic motivation is not related to web technology.

8. Rich information provision can be successfully implemented using web-based technology due to the media's capability of distributing both text, sound, and image via standards and open interfaces. However, to support awareness of users with particular interests or expertise and facilitate collaboration between these users, new tools are needed. It has for example been suggested that IR tools have the potential of providing these services but that this potential is not currently exploited. Tools not only based on Boolean logic, but rather on similarity between items would support creative work by facilitating the finding of analogies and more loosely related material. Intranet recommender systems are now working examples of IT artefacts that provide loosely related information as part of the users everyday web activities (Stenmark 1999b).

Discussion and summary

Numerous commentators hold strong alignment, organisational intention, or shared visions to be essential enabling conditions for knowledge creation (cf. Robinson & Stern 1998, Nonaka & Takeuchi 1994, Senge 1990). It is claimed that assuring that all employees in the company are aware of, and are working towards, the same set of key goals creates a focus necessary for creativity. Arguing for alignment, Robinson and Stern (1998) report from the former Soviet Union where factory directors each month were required to report a certain amount of proposals, and therefore often had to fabricate ideas to meet the quotas. The authors claim this to be an example of how a misalignment problem destroys creativity.

However, the same authors also tell the story of how the pharmaceutical company G. D. Searle and Co. by a series of fortunate events in their laboratory came to discover NutraSweet. While working on a new drug, the company stumbled over what would come to be the perhaps most profitable product in the firm's history – a sweetener. A strongly aligned company would have reacted as one of the senior managers did when he heard of the discovery: "*So what? We're a drug company, not a food company*" (*ibid.*, p.37). However, the company proceeded with the sweetener and indeed, ended up as a food company. Here, when the authors indeed present an example of misalignment, the company in question is successful.

To me it seems that the key issue is not related to alignment. The goal for the Soviet managers was to meet a quota and they were very much aware of this goal. In that sense, the directors were aligned. Being strongly aligned, there is an obvious risk that profitable business opportunities are missed because employees that stumble over such an opportunity do not explore it since it falls outside the strategic vision set by management. An all too focused organisation may thus hamper creativity and prevent knowledge not planned for to be created. The real issue, I claim, is not whether you are aligned - it is whether you recognise the non-preconception principle. By establishing quotas for creativity in the example above, Moscow implicitly assumed that it could be predicted who would be creative – and when – thus violating the principle, and this is what caused the failure. In conflict with other commentators, I do not consider alignment to be a necessary condition for successful knowledge creation.

To summarise, this paper contributes by presenting a theoretical framework for corporate knowledge creation, where eight enabling conditions are identified and explained: The no-preconception principle; Self-initiated activities; Serendipity; Diverse stimuli; Intra-corporate communication; Trust and reciprocity; Motivation, and; Rich information provision. I further link this framework to web technology exemplifying how intranets in particular may be used to implement and support most of these key conditions.

Much of what is discussed above requires a level of redundancy not often found in today's lean organisation. As pointed out by Nonaka and Takeuchi (1995) redundancy conflicts with the Western idea of efficiency. Still, a certain level of organisational slack must be allowed to enable self-initiated activities and provide intrinsic motivation. Without those highly interrelated conditions, the full potential of the organisations creative power cannot be commodified.

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Defining a flexible methodology for supporting generation of structured hypermedia content in the Web

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Abstract: We deal with the problem of structured hypermedia content generation in the Web. More specifically, we focus on content that analyzes a certain thematic topic. We review existing methodologies and tools that relate directly or indirectly to the topic and we propose a methodology for supporting generation of such content by allowing customization where possible. We have implemented most steps of the proposed methodology as thematic-based collections in the Hellenic Ministry of Culture (HMC) web site. Some of these collections are presented in the last section of the paper.

Introduction

In this paper, we are concerned with the problem of structured hypermedia content development in the Web and, more specifically, how we can support automatic generation of such content targeted on a specific topic. In this case of content and, especially, when having to cope with real-life content, there are some particular requirements that need to be carefully dealt, such as efficient and flexible content structuring, followed by support for its manipulation and further exploitation in other circumstances. Moreover, the content's presentation should be enriched with various kinds of multimedia content. Other issues include handling of special instances of content and embedding well-organized interactivity in the content's pages. There are many methodologies and tools that deal with several issues of the problem, but we could hardly find a previously defined attempt dealing with all the above issues. However, we have been motivated by similar ideas and tools, some of which are presented next, and by real-life projects, which we have developed and are presented in the showcase section, in order to compose a flexible methodology for guiding content providers and web developers in the various stages of structured hypermedia content generation.

Related issues

Several aspects regarding the development of structured hypermedia content have been analyzed in the past. Some propositions deal with content organization and importing, while others focus on the navigation process and respective tools. Some methodologies and guidelines have also appeared focusing on the development of generic hypermedia applications. We will cover some representative tools and methodologies.

Linking / Navigation Tools

With a new kind of linking mechanism proposed in (Hartman 97), the hyperlinks' destinations are not embedded in a document and a hyperlink may point to more than one documents. This method deals with the problem of link inconsistency. Another kind of linking mechanism is described in (Lewis 96). The notion of generic link is introduced that enables association of a hyperlink to a certain piece of content, either textual or non-textual, and the activation of the hyperlink upon every occurrence of the associated piece. This feature helps simplifying and decreasing errors when embedding hyperlinks in documents, as these are defined once and are easily used when necessary. The content organization we define in our methodology helps us dealing with these problems. A set of navigational aids has also appeared in literature. (Kopetzky 99) describes a tool for annotating hyperlinks that appear on a page. A tool for navigating info hierarchies is also discussed in (Elo 99), where, however, emphasis is given on web resources. Furthermore, there are tools, such as LivePage (http://www.livepage.com), which automatically build navigation structures. These tools are efficient when dealing with simply structured content, but their capability shrinks as complexity grows. There are also graphical tools that help constructing navigation structures, such as guided tours, as shown in (Juehne 98).

Methodologies

There is a series of methodologies and guidelines that discuss design and navigation issues in hypermedia. As proved in (Christodoulou 98), OOHDM (Schwabe 95) appears to be the most efficient such methodology, which, however, offers little practical guidance especially during the initial step of content organization. RMM (Isakowitz 95) is most suitable for navigating through tightly related data. HSDL (Kesseler 95) helps defining interrelating object-oriented entities and supports content importing and generation of tables of contents and other navigational cues within entity pages. (Lyadret 98) presents some guidelines regarding content design, navigation and user interface issues of educational applications. A basic guideline is that a certain page should cover a certain and solid meaning. Additionally, in a hypertext page, there must be a distinction between the main content and the part where navigation structures are displayed. Furthermore, a certain page may lead to a set of supplementary pages that further analyze its meaning. In (Rousseau 99), a specialized tagged language is introduced for organizing various presentation formats of a given content.

General Requirements

Some case studies and reports also provide some valuable outcomes. (Garzotto 95) presents guidelines and reviews on navigation design based on actual hypermedia applications. In a study concerning using Internet in education (Hartley 96), it is stated that there is need for conversion tools from various sources to HTML, as well as authoring tools for producing new content. Furthermore, among the requirements for a web-based application used for managing and displaying the content of many pages (Balasubramanian 97), it is mentioned that intuitive navigation mechanisms should be developed for helping end-users locating desired information. (Rockley 93) describes the process, the requirements and desired features of a system for producing hypertext from existing, large-scale content. Some important requirements include an efficient importing process from existing content, strong navigational capabilities under various contexts.

Related technologies

We believe that the Web community can gain experience from functionality found in popular multimedia development applications, such as Macromedia Director (http://www.macromedia.com). An example is the association of behaviors to objects, which are activated in every object use. As later examined, we can take advantage of the behavior concept when dealing with structured hypermedia content. Furthermore, a set of commercial web development tools can be used for integrating HTML scripting with database content, such as ColdFusion (http://www.allaire.com) and ASP (http://www.microsoft.com). Finally, XML has been designed for adding structure to the Web. Recently, a series of mature tools has appeared for converting and managing XML content, such as XML Translator Generator (http://www.alphaworks.ibm.com/) and Bluestone XML-Server (http://www.bluestone.com /xml/XML-Server/) respectively. XML can be used for storing structured hypermedia content, although, as later explained, we propose that a database should be used instead.

Developing structured hypermedia content in the Web

In this section, we define a flexible but methodic procedure for producing hierarchically structured content in the Web, which analyzes a specific topic. In this direction, we integrate some features found in the above methodologies. The extension (Styliaras 99) defined to the ITC system (an automatic tool for constructing Subject Catalogs) was our first approach towards supporting automatic generation of predefined and tightly structured content in the Web. However, as later exemplified, when dealing with real-life content that may be loosely structured, originate from diverse sources and require multiple presentation formats, a flexible methodology is needed in order to seamlessly combine all kinds of content and presentation needs. We do not present an automatic tool for constructing hypermedia content, as such a tool, even as general as it might be, cannot cope efficiently with all the content peculiarities that may arise in a certain content instance.

Definition

We emphasize on a certain case of structured hypermedia content that deals with the deployment of a thematic topic in the Web. We call this kind of content *a thematic-based collection*. A thematic topic can be a museum, an exhibition, a library, or, generally, a well-organized knowledge area. It can be analyzed in a hierarchy of *objects* such as a museum exhibit, a book or a cinema film. From an architectural point of view, in every level of the collection hierarchy, there is a set of *chapters*, which represent the categories in which the collection is structured. Additionally, every chapter in a certain level may point to lower level chapters, which further analyze its meaning. A set of *collection pages* is associated to every chapter. Every such page analyzes a self-contained object that belongs to the collection. A collection page has a title and some basic text organized in a set of fields, according to the desired presentation. It is also accompanied by a textual description and some discrete attributes annotating the page. Furthermore, we define *a uniform pool of multimedia content* consisting of images, slideshows, sound and video, which can be used for enriching the presentation of the main collection pages. Moreover, extra *indexes* may be created for providing alternative access routes to the collection pages, apart from the main navigation option based on chapters. Figure 1 gives an overview of the collection structure at a certain Level I.

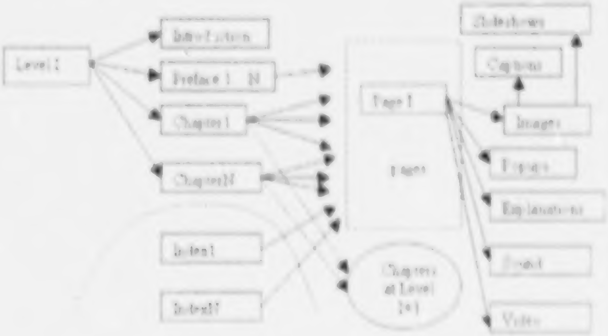

Figure 1: Structure of a thematic-based collection

Content import

We assume that the content used as a basis for a thematic-based collection already exists in some electronic format. On the opposite, there are many ways to digitize any printed text or images. (Kommers 98) describes many methods for doing such conversions. Main content types include text, image, sound and video. Among them, text and image are the most popular formats. The major requirement in case of text is to be able to extract it in plain format by, optionally, maintaining most of the common formatting. It would be also useful to automatically recognize the text's structure in chapters and, possibly, indexes, enabling, thus, the generation of navigation structures. Other types of multimedia content are similarly dealt.

Content structure and organization

We propose to use a database for storing the collection content. As said before, XML could be also used, but a database, having stronger query and storing capabilities, still provides better support for content retrieval and automatic generation. More specifically, the database is used for storing the textual data of the collection, its classification in chapters and indexes, its internal structure according to fields and other defined metadata. Additionally, we define tables describing the multimedia content that accompanies the collection's pages. A unique table is used for every kind of multimedia. A piece of multimedia is described by a caption and description, which may be overridden in specific uses of multimedia pieces, and other supplementary metadata that are unique for every multimedia kind.

Navigation structures

The first kind of navigation is through the representation of the collection's structure based on chapters. The collection's home page includes links to the first-level chapters. Each such page contains links to the objects' pages that directly belong to the chapter and, possibly, links to other subchapters, in which a chapter is further analyzed. Furthermore, navigation is possible by using the additional indexes that may be defined.

Generation process

An automatic process should be used for generating HTML pages for the main collection objects and the navigation structures by exploiting the way content is structured and stored in the database. More specifically, concerning collection pages, their basic text will be included enriched with the appropriate hyperlinks, supplementary multimedia data and navigation cues. Concerning hyperlinks, these are never hardwired in pages but are calculated based on the collection object IDs. We also define behaviors as configurable scripts that can be embedded into objects such as images, hyperlinks and navigation elements. Behaviors can be used to enhance the interaction with the collection content and are executed whenever these objects are used in collection pages. They are stored in the database where they are associated with the appropriate objects and they are converted to working HTML code during generation process. This is the general philosophy of our methodology: When possible, we try to define configurable content (such as image captions and behaviors) and we allow that this content is instantiated or overridden in specific cases. Furthermore, we may embed some extra, manually developed content in some pages' presentation and support synchronization between automatic generated and manually developed content in case of editing. The appearance of automatically generated content in terms of structuring blocks may be configured using templates (Styliaras 99).

Administration

We allow two kinds of administration options that mainly address the needs of content providers. Firstly, page-based administration is used for editing the collection content on a page basis. The user has to determine which page to edit by providing some search criteria such as phrases to be found in the basic content and classification criteria according to chapters and indexes. A list of pages matching the criteria appears from which a user chooses a page to edit. More specifically, the basic text may be edited, along with its attributes, multimedia metadata and hyperlinks. Secondly, structure-based administration may be used for updating the collection's structure with regards to chapters and indexes. Finally, using the administration options, a web developer may create hand-made access structures for presenting more interactively the collection's content. The first step for implementing such a structure is to implement a prototype using e.g. Dynamic HTML or ActiveX. Then, an interface should be defined for filling the structure with appropriate collection content.

Showcase

During the development of the HMC web site, we had the opportunity to construct structured hypermedia content in the form of thematic-based collections, covering specific subject areas and user-interface needs. Most of the functionality already proposed has been implemented in the collections presented and we had the chance to check and refine our methodology based on actual data. The implemented functionality includes importing content, hand-made access structures, temporally synchronized slideshows and administration forms for content editing.

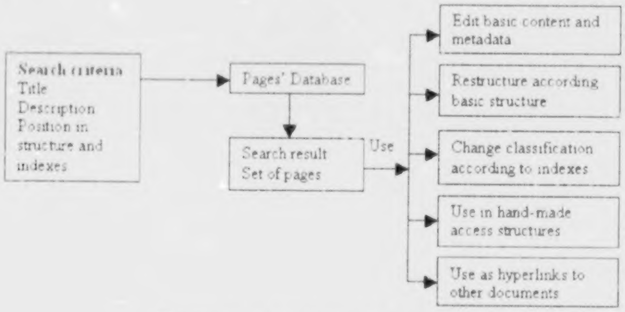
Search criteria
Title
Description
Position in structure and indexes
Pages' Database
Search result
Set of pages
Use
Edit basic content and metadata
Restructure according basic structure
Change classification according to indexes
Use in hand-made access structures
Use as hyperlinks to other documents

Figure 2: Administration options

The Treasures of Mount Athos

The first collection (http://www.culture.gr/2/21/218/index.html) focuses on the relics stored in the monasteries of Mount Athos. The main source for the collection was a book presenting the relics. 566 objects of relics are presented. Every relic is described in its own page by a title, a small description, some technical data and images displaying the object. There are three main classifications pointing to the relics' objects: the monastery where the relic is located, time season and thematic category. There are 22 thematic categories that are classified in 5 broader categories: Painting, Sculpture, Minor Arts, Historical Archives and Libraries.

Cinema in Greece

The second collection presents bilingually the films sponsored by the Greek Film Center from 1981 to 1997 (http://www.culture.gr/2/22/222/22200/chrono/chrono.html). The source for this collection was the films' advertising printed posters. As each poster was uniquely formatted, it was not possible to adapt or even write from scratch an automated importing script. Therefore, a new database has been created where information about every film and its contributors has been manually entered using appropriate administration forms. For every film, there is a description extracted from the advertising poster, a small review and information about direction, producing, scenario and cast. For every category of contributors, a separate table has been created in the database. In this way, it was possible to build multiple indexes and respective navigation structures on the films' content the most important among which being production year and direction. Moreover, a hand-made access structure has been developed for the chronological-based navigation, consisting of an image-map like stripe from which a certain year may be selected. The selected year's films are listed in a separate frame, from which a film may be further selected and displayed in the main frame. Content organization has helped to automatically populate the structure with content about the films. Furthermore, a poster is displayed for every film, along with slideshows presenting scenes from the film. Metadata such as the number of images used are stored in the film's record in the database.

Hellenic Jewelry

This collection presents some important items of the Hellenic Jewelry (http://www.culture.gr/2/22/225/22501/e2250100.html). About 500 jewels are presented. Every collection object describes a certain

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jewel. For every jewel, there is a title, a small description and some technical data, such as dimensions, material, current location, code number and origin. Two indexes have been defined in order to access the jewels' pages. More specifically, jewels are firstly classified into five main chronological categories. Every chronological category is also accompanied by an introductory text that is enriched with hyperlinks pointing to representative jewels' pages. The second classification is based on the jewels' current location. The basis for the collection content was a Quarck Xpress file. An importing script has been developed and adapted to the input file formatting. Paragraph changes and other common formatting used in the text have been exploited in order to extract content and store it in the appropriate database fields.

Conclusions

We have presented a methodology for developing structured hypermedia content in the Web. Using the methodology, both content providers and web developers can cooperate in order to build well-structured hypermedia applications, ranging from information delivery to education. The proposed procedure includes guidelines for all the steps involved in the presentation of a certain thematic topic, including content importing, structuring, enrichment with multimedia data, configuration of navigation structures and page generation. Furthermore, an efficient administration framework has been proposed and used in various instances for manipulating the content. We plan to extend the capabilities of this framework, as we think that such a data-centric interface gives the necessary flexibility for better exploiting and reusing the gathered content.

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Course Design Factors Influencing the Success of Online Learning

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Abstract: *This paper looks at factors affecting the success of asynchronous online learning through an investigation of relationships between student perceptions and course design factors in one of the largest asynchronous learning networks in the country. It finds that three such factors -- consistency in course design, interaction with course instructors, and active discussion – have been consistently shown to significantly influence the success of online courses. It is posited that the reason for these findings relates to the importance of building community in online courses.*

Among the many and various possibilities occasioned by the growth of the World Wide Web (WWW), one of the most promising is distance education. In the rush to create online courses, however, the major focus has too often been on technological issues, whereas, as Mason (1994, p. 52) argues, "Social and pedagogical issues play by far the bigger part in the creation of a successful [online] learning environment."

In this paper, we document the efficacy of pedagogical approaches which foster online community. We first review the literature on the effects of course design features on student satisfaction and learning online. We then report our own findings on these topics from data collected during the Spring, 1999 semester from SUNY Learning Network (SLN) courses. Finally, we discuss these findings in the light of social constructivist theory.

Background

All asynchronous online courses have important features in common. Kearsley (2000), for example, asserts that the virtual classroom is a "unique social context, much different from that of a regular classroom." On the other hand, online classes can be as various as face-to-face classes. Moreover, online, course interfaces are students' sole connection to instructors, peers, and the course materials, so their impact is magnified. Indeed, researchers have argued that the structure (Romiszowski & Cheng, 1992), transparency (Eastmond, 1995), and communication potential (Irani, 1998) of course interfaces heavily impact students' satisfaction, learning, and retention in online courses. Of particular importance, it seems, is the ability of the interface to facilitate interactions between students and teachers and among students.

The relationship between student-teacher interactions and learning outcomes has been well documented in traditional classrooms (Powers & Rossman, 1985). It stands to reason that interactions with instructors would be equally important online. Indeed, Picciano (1998) found that instructors' activity was related to students' perceived learning in online education courses. Richardson and Ting (1999) compared the perceptions of two groups of students involved in asynchronous learning. They found that students learning through written correspondence with instructors were more concerned with instructor feedback, whereas students learning online felt that all interactions with instructors, including instructor participation in class discussion, mattered. Jiang and Ting (1998) found correlations among students' perceived interactions with instructors and the average numbers of responses per student that instructors made and the average numbers of responses students themselves made in course discussions.

Indeed, course discussions seem to be one of the most influential features in online courses. Perhaps this is because online discussions are significantly different from face-to-face discussions. To begin with, all students have a voice and no students can dominate the conversation. The asynchronous nature of the discussion makes it impossible for even an instructor to control. Accordingly, many researchers note that students perceive online discussion as more equitable and more democratic than traditional classroom discussions (Harasim, 1990; Levin, Kim & Riel, 1990; Siegel, et al., 1998). In addition, because it is asynchronous, online discussion affords participants the opportunity to reflect on their classmates' contributions while creating their own, and on their own writing before posting it. This tends to create a certain mindfulness among students and a culture of reflection in the course.

However, as Eastmond (1995) reminds us, computer-mediated communication is not inherently interactive, but depends on the frequency, timeliness, and nature of the messages posted. Hawisher and Pemberton (1997) relate the success of the online courses they reviewed to the value instructors placed on discussion. Students in these courses were required to participate twice weekly and 15% of their grades were based on their contributions. Picciano (1998) found that students' perceived learning from online courses was related to the amount of discussion actually taking place in them. Likewise, Jiang and Ting (1998) report correlations between perceived learning and the percent of course grades based on discussion, and between perceived learning and the specificity of instructors' discussion instructions.

Such findings indicate that interaction among students is an important factor in the success of online courses. This could lead us to suspect that collaborative learning activities might also be supportive of success. However, researchers who have investigated collaborative learning online have found it remarkably unsuccessful (Hawisher & Pemberton, 1997; Siegel, et al., 1998; Sturgill, Martin & Gay, 1999). Whether collaborative learning itself does not mesh well with asynchronous formats or we have yet to discover effective ways to support collaboration online remains to be seen.

In summary, research to date indicates that the most successful online courses are well structured and easy to use, and take advantage of the increased access to instructors and more equitable and democratic discussion possible in online environments.

The SUNY Learning Network

The SUNY Learning Network is the infrastructure created to support asynchronous online courses for the sixty-four institutions and nearly 400,000 students of the State University of New York (SUNY) system. It's primary goals are to bring SUNY's diverse and high quality programs within the reach of learners everywhere, and to be the best provider of asynchronous online instruction it can. With generous support from the Alfred P. Sloan Foundation, SUNY System Administration, and participating campuses, it has grown from offering eight courses to 119 students in the 1995-96 year to its current offering of more than 1,000 courses to over 11,000.

Methodology

In the spring of 1999, approximately 3,800 students were enrolled in 264 courses offered through SLN. At the end of the semester, students in all courses were asked to complete an online survey eliciting demographic information (8 questions) and students' perceptions about their satisfaction, learning, and activity in the courses they were taking (12 questions). Demographic questions concerned students' age, gender, academic level, employment, proximity to campus, prior computing and online experience, and their reasons for taking an online course. The more pertinent student perception data included their satisfaction with the courses, perceived learning from them, perceived interactions with instructors and peers, and personal activity in the courses. Fourteen hundred and six (1,406) students returned the survey. Survey data was analyzed using a series of one-way analyses of variance that looked for significant differences in student satisfaction and perceived learning relative to the other factors measured. The survey data was also averaged by course for use in correlations with course design data.

Because we were especially interested in actual course designs and the relationship between course design features and student perceptions, we looked at course variables in the 73 courses for which there was a 40% or greater rate of return on the student satisfaction survey. Two of the researchers separately examined each of the 73 courses and rated their content on 22 variables using Likert-type scaling. The variables examined can roughly be categorized as general course structure variables (course level, enrollment, the number of course modules and the consistency between them, the graphical quality of course pages, the number of links to external sources, textbook requirements, and instructor voice); interactivity variables (frequency and gaps in instructor interaction and feedback, frequency of interactions between students, required participation in discussion, authenticity of discussion questions, and the average length of discussion responses); and assessment variables (how often assignments were due and the percentage of the course grade that was based on papers, other written assignments, projects, quizzes and tests, discussion, and/or cooperative or group work). Ratings for each course were checked for agreement, and disagreements were resolved by consensus with reference to the courses themselves. Averages for student satisfaction, perceived learning, interaction with instructor, and interaction with peers were computed and added to individual course design records. Correlations were then run to look for relationships between course design variables and student perceptions. Because rankings along the various course design variables were not normally distributed, two-tailed Spearman's correlations were employed.

Results

All four student perception variables – student satisfaction, perceived learning, perceived interaction with the instructor, and perceived interaction with peers – were highly interrelated, but not identical.

Student satisfaction with the courses they were taking and their perceived learning from them were the most highly correlated variables we examined ($r = .784$, $p < .01$). The more students thought they learned from courses, the more satisfied they were with them. These two variables clearly did not measure the same perceptions, however, as shown in some of the correlations with course design variables that were significant for one but not for the other.

Correlational analyses also show that the more interaction students believed they had with their instructors, the more satisfied they were with their courses ($r = .761$, $p < .01$) and the more they thought they learned from them ($r = .707$). One-way analyses of variance also showed significant differences in student satisfaction ($F_{(3,1402)} = 188.97$, $p < .01$) and perceived learning ($F_{(3,1402)} = 168.25$, $p < .01$) among students interacting with their instructors at differing perceived levels. Students who reported low levels of interaction with their instructors also reported the lowest levels of satisfaction with their courses and the lowest levels of learning. Conversely, students who reported high levels of interaction with their instructors also reported higher levels of satisfaction with their courses and higher levels of learning from them. These findings highlight the critical importance of instructors' interactions with their students in online environments.

Similarly, the more interaction students believed they had with other students, the more satisfied they were with their courses ($r = .440$, $p < .01$), and the more they thought they learned ($r = .437$, $p < .01$). In addition, analyses of variance found significant differences in students' satisfaction with the courses they were taking ($F_{(3,1402)} = 68.91$, $p < .01$) and perceived learning from them ($F_{(3,1402)} = 50.27$, $p < .01$) for differing levels of perceived peer interaction. Students who rated their level of interaction with classmates as high also reported significantly higher levels of course satisfaction and significantly higher levels of learning. The findings point to the importance of creating interaction among classmates in online courses.

Perceived interaction with course instructors and perceived interaction with peers were also highly correlated ($r = .517$, $p < .01$). In addition, significant differences in student satisfaction ($F_{(3,1402)} = 44.21$, $p < .01$) and perceived learning ($F_{(3,1402)} = 90.20$, $p < .01$) were found among students reporting differing levels of activity in the online courses they were taking. Students who rated their level of activity as high also reported significantly higher levels of course satisfaction and significantly higher levels of perceived learning. These findings, once again, highlight the importance of creating opportunities for frequent and engaging student participation in online courses, especially participation interaction with each other and with their instructors. Taken all together, these results suggest that the development of online communities is a major contributor to the success of online courses.

The greater the percentage of the course grade that was based on discussion, the more satisfied the students were, the more they thought they learned from the course, and the more interaction they thought they had with the instructor and with their peers. The greater the percentage of the course grade that was based on cooperative or group work, the less students thought they learned from the course.

The correlation between the percentage of the course grade that was based on discussion and students' satisfaction with courses was significant ($r = .381$, $p < .05$). The correlation between the percentage of the course grade that was based on discussion and perceived learning approached significance ($r = .286$, $p < .10$). Thus, students were more satisfied with courses and believed they learned more when greater value was placed on discussion. Higher values put on discussion were also found related to greater perceptions of instructor ($r = .307$, $p < .05$) and peer interaction ($r = .455$, $p < .10$). Taken together, these findings point to the efficacy of discussion, and in particular to the value put on discussion, in online courses. The findings also suggest that shared discourse among students and instructors has a positive effect on student satisfaction with courses. They support previous findings linking the valuing of discussion to student satisfaction and learning (Hawisher & Pemberton, 1997; Jiang & Ting, 1998; Picciano, 1998), and further demonstrate the importance of discussion online.

Our results also show, however, that the greater the percentage of the grade that was based on cooperative or group work, the less students believed they learned from the course ($r = -.320$, $p < .05$). This finding replicates those of other researchers who have explored collaborative learning online (Hawisher & Pemberton, 1997; Siegel, et al., 1998; Sturgill, Martin & Gay, 1999). Student comments indicate that it was difficult to get group members to work together on projects in the few courses in which collaborative learning was tried. This may stem from embedded problems with asynchronicity. On the other hand, it may stem from instructor naivete concerning collaborative work. Future research clearly should explore this issue further and look for ways to successfully employ collaborative strategies online.

The greater the consistency among course modules, the more satisfied students were, the more they thought they learned, and the more interaction they thought they had with their instructors. The lower the number of modules in a course, the more students believed they learned from it.

Significant correlations were found between consistency among course modules and student satisfaction ($r = .333$, $p < .05$), perceived learning ($r = .474$, $p < .01$), and interaction with instructor ($r = .451$, $p < .01$). All of these correlations favored greater consistency. In addition, perceived learning was found to be related to the number of modules in a course ($r = .338$, $p < .01$). The fewer the number of modules a course had, the more likely students were to report higher levels of learning from it. The strength and persistence of these correlations demonstrate the superiority of straightforward course designs with relatively few, similarly structured modules. They support previous findings that link course structure to student satisfaction, learning, and retention ((Romiszowski & Cheng, 1992; Eastmond, 1995; Irani, 1998). Taken together, these findings highlight the fact that, lacking face-to-face communication, it is easy for students to get confused or lost in complex course structures.

Students' perceptions of interaction with their peers were related to actual interactions in courses, the percentage of the course grade that was based on discussion, required participation in discussions, and the average length of discussion responses.

A strong correlation was found between students' perceptions of their interactions with peers and the actual frequency of interactions between students (r = .398, p < .01). This finding demonstrates the accuracy of student perceptions. We also found correlations between students' perceived interaction with peers and the percentage of the course grade that was based on discussion (r = .455, p < .01), the required frequency of participation in discussion (r = .369, p < .05), and the average length of discussion responses (r = .353, p < .01). The results replicate previous findings (Hawisher & Pemberton, 1997; Jiang & Ting, 1998; Picciano, 1998). Taken together, they suggest that discussion fosters interactivity among students and that several factors contribute to successful online discussions. Some of these are the value instructors place on discussion, the frequency of participation in discussions they require, and the average length of students' discussion responses.

Students' perceptions of interaction with their instructors were related to the percentage of the course grade that was based on discussion and to the frequency of instructor feedback.

As previously noted, a correlation was found between students' perceived interaction with the instructor and the percentage of the course grade that was based on discussion (r = .307, p < .05). Students' perceived interaction with their instructor and the actual frequency of instructor feedback approached significance (r = .269, p < .10). These findings, while weaker than findings concerned with peer interactions, once again demonstrate the accuracy of student perceptions, and highlight the importance of instructors' activity in online courses (Jiang & Ting, 1998).

Discussion

The findings of the research on computer-mediated communication and asynchronous online learning are quite consistent. They point to three (and only three) course design factors that contribute significantly to the success of online courses. These are a transparent interface, an instructor who interacts frequently and constructively with students, and a valued and dynamic discussion. This study, which looks at such factors across 73 courses with a similar high level interface, both corroborates and elaborates these results.

It is our belief that this combination of factors is not an accident, but rather that they jointly support the growth of what Scardmalia & Bereiter (1996) call "knowledge building communities." We agree with many in the online education field that the development of such communities is critical to the success of online courses (Harasim, 1990; Wegerif, 1990). Wegerif, for example, relates the success or failure of individuals enrolled in Open University courses to the extent to which they could "cross the threshold" from feeling like outsiders to becoming a part of the online community. Similarly, Romiszowski & Corso (1990) suggest that computer-mediated communication is essentially social constructivist in nature. According to Kearsley (2000), it may be uniquely so.

The identification through empirical research of these three factors – consistency in course design, contact with course instructors, and real communication through discussion – is both supported by social constructivist theory and supports social constructivist notions of the importance of the development of knowledge building communities. It also can guide the development of asynchronous online courses. It very well may be that other theoretical approaches can be successfully instantiated online. At present, however, the efficacy of social constructivist designs has been quite clearly demonstrated and surely deserves further, in depth, investigation.

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XML-based Event Notification System for Large Scale Distributed Virtual Environment

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Abstract: In this paper, we propose XML based event notification system in distributed virtual environments. The proposed system imports a notifier model of which event receivers can add and remove dynamically without affecting system. The system defines basic event types, and then those events are expressed with XML, which is standard of information transmission in the WWW to be operating independently specific application on other environments. Because the system expresses event using XML, it can store occurred event log data and can use filtering and retrieval of event using log data to improve effectiveness. Also, filtering is improved with which system allow participant to register their interested event. Finally, our system can utilize interoperability between applications of other virtual reality as well as XML based applications

1. Introduction

Recently, it is increased interest about virtual reality according to developing Internet technology including VRML rapidly, due to development of computing ability and advancement of network (VRML 1997). Especially, it becomes to need event notification model for interoperability between virtual reality systems (Hagsand 1996, Funkhouser 1995).

Nowadays, most virtual reality systems use their own system and event notification model. There are problems which systems of different environment have difficulty of which apply to each event and which they are difficult to interoperability with occurred events. Therefore, it needs system which can accept events occurred in other virtual environments and which can filter through events occurred between virtual applications. Especially, filtering is a need part because events are occurred too much in virtual environments. Also, in case of collaborative work, events should be managed for event filtering and retrieval (Funkhouser 1995, Brandt & Kristensen 1997).

Therefore, we propose XML based event notification system in distributed virtual environments. The proposed system is a notification model, and we design notifier which implement notification model provided dynamic event registration of event receiver and which has property of separating event senders with receivers. This notifier is appropriate with virtual environments, which make a change between event senders and receivers frequently. Also, this system is independent of application domain because it defines event format using XML, which is content-based structured data and self-describing standard of information transmission. The system filters events using XML and makes easy retrieval of event through database of occurred event log data using XML. Finally, this system can utilize interoperability between applications of other virtual reality as well as XML based applications

2. Related Works

We will survey about event distribution model and XML (eXtensible Markup Language), which is standard of data transmission type.

2.1 Event Distribution Model

Classic model

The simplest event distribution model is that event sender pass events to receiver directly. This way has a disadvantage, which is event receiver should have reference of all event senders. The followings are approaches to overcome this disadvantage.

Mediator model

This approach is that Mediator is existed between event receivers and senders. That is, event senders send events only Mediator and then Mediator pass events to event receivers. The disadvantage of this model is that it should be modify Mediator's list, which is managed to event receivers if event receivers increase (Gupta et al. 1998, Gamma et al. 1997).

Observer model

This approach allows event receivers to register their interest events, and event receivers receive only their registered events when events occur. This Observer approach has an advantage, which can extend system without affecting other participants although event receivers increase. However, event receivers have to know about information of event senders (Gupta et al. 1998, Gamma et al. 1997).

Event Notifier model

This approach combines the benefits of both the Mediator and Observer approaches, as shown in Figure 1. Like in the Mediator approach, we have a central event service that mediates notification, so that event senders and event receivers do not need to know about each other. Like in the Observer approach, a registration system allows us to add and remove observers (called subscribers) dynamically (Gupta et al. 1998, Gamma et al. 1997).

Figure 1 is illustrated UML notation for event notifier model (Gamma et al. 1997).

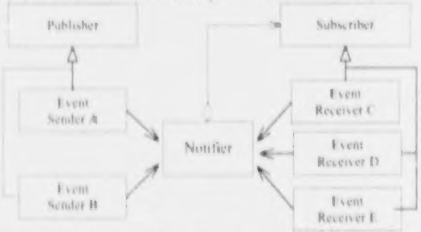

Figure 1. UML notation for Event Notifier Model

2.2 XML

XML is defined as subset of SGML (XML 1998). It formalize data in simple and consistent way, and provides structured data type for transmission. On heterogeneous platforms, it support to define contents clearly, and to gather meaningful search results.

XML documents are combined with DTD (Document Type Definition), and is regarded valid when based rules defined in DTD. DTD defines tag used in XML documents, processing sequences, and specific tags can include others. XML can provide easily extensible and structured form of data.

Using XML, we can accept requirements of content based event format to standard of content-based structured data and self-describing information transmission. Also, we can offer event filtering and QoS through filtering and then it is very useful database of event log information.

3. Design of System

The event-processing scheme in legacy VR environment is dependent to the implementing system, and the definition of events is dependent to applications of system. Therefore, we propose a generic event notification system to eliminate these dependencies.

The proposed system designs Notifier to interface with external services having different VR environments, and performs event filtering to reduce the amount of events. Additionally, we describe events based on XML, so it increases the efficiency of interaction with external services and makes searching convenient through event logs management.

Figure 2 shows the architecture of designed event notification system.

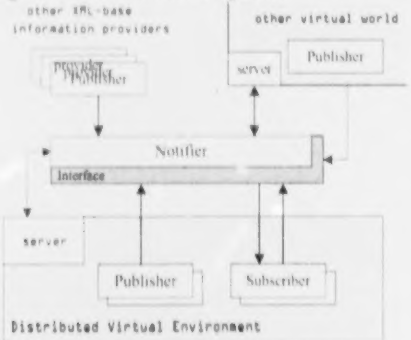

Figure 2. Event Notification Architecture

The designed notifier has following features.

- It simplifies complex event propagation routes by providing transparency between publisher and subscriber.
- It makes an easy to insert or delete the receiving events of shared objects or specific information dynamically regardless of system when it uses different interaction ranges according to avatar. The definition of method about these interaction ranges is dependent on the management of VR environments, but it is independent of notification system.
- It provides dynamic filtering facilities. Subscribers can personalize events propagated through the registration of filter about specific events to notifier. Events described in XML are also possible to filtering of event contents using searching and conversion of XML tags because XML based events are hierarchical and self-describing.
- It can interact with legacy applications dependent on domain. And it enables to convert XML formed events with the registration of applied application interfaces to notifier.

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3.1 event specification

The basic event types for accepting events in VR environment are defined as follows.

We use XML to describe events because it is possible content based filtering and is convenient to build database of log information. In addition, these information are useful to retrieve events generated, and write working information or behavior patterns of participants in VR environment.

- ***Action Event***

Action events are generated when the object status is changed, or when active behaviors are happened. These events are related with persistency maintenance of VR environment. They are defined as follows according to the degree of synchronization.

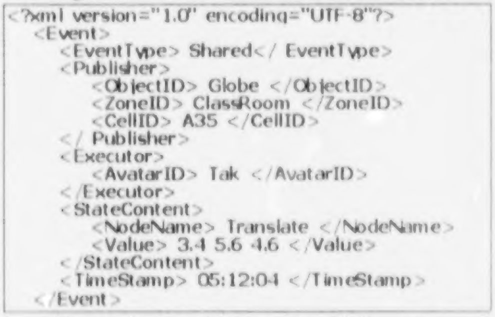
- Independent interaction event: This event is generated independently regardless of participants such as movement of custom objects or changes of avatar location. Recent events can be substituted for previous events because it does not effect other participants immediately. However, this should be reflected upon other clients for consistency.
- Shared interaction event: This kind of event effects other clients immediately, so it has to be reflected firstly of all than independent events. For example, events generated in cooperative work should be reflected on participants firstly.
- ***Information event***

This event has no connection with the synchronization of virtual environment. It is not notified for consistency immediately, but should be transmitted. This event is generated when mail type data is propagated to internal external virtual environment, or when the previous log data is requested from system.

Figure 3 is a DTD for data structure of events, and Figure 4 is a sample event that describes the data structure of shared Interaction event using XML Syntax. This is event that avatar named "Ellio" makes a movement the target object of cooperative work, "CoWork", according to the value of attribute <vec3fx>.

```
<?XML version=1.0/>
<!ELEMENT Event (EventType)>
<!ELEMENT EventType (Independent | Shared |
Information)>
<!ELEMENT Independent
(Publisher, Executor?, CellID?, StateContent+,
TimeStamp)>
<!ELEMENT Shared
(Publisher, Executor?, CellID?, StateContent+,
TimeStamp)>
<!ELEMENT Control (Publisher ,
ControlContent, TimeStamp >
<!ELEMENT Message (Publisher,
MessageContent, TimeStamp)>
<!ELEMENT StateContent ((NodeName, Value)+)>
<!ELEMENT NodeName (#PCDATA)>
<!ELEMENT Value (#PCDATA)>
<!ELEMENT MessageContent (#PCDATA)>
<!ELEMENT Publisher
(ObjectID | AvatarID | ManagerName, (ZoneID,
CellID)?)>
<!ELEMENT Executor(ObjectID | AvatarID)>
<!ELEMENT ObjectID (#PCDATA)>
<!ELEMENT AvatarID (#PCDATA)>
<!ELEMENT ZoneID (#PCDATA)>
<!ELEMENT CellID (#PCDATA)>
<!ELEMENT ManagerName (#PCDATA)>
<!ELEMENT TimeStamp (#PCDATA)>
```

Figure 3. DTD for Data structure of Events



```
<?xml version="1.0" encoding="UTF-8"?>
  <Event>
     <EventType> Shared</ EventType>
     <Publisher>
        <ObjectID> Globe </ObjectID>
        <ZoneID> ClassRoom </ZoneID>
        <CellID> A35 </CellID>
     </ Publisher>
     <Executor>
        <AvatarID> Tak </AvatarID>
     </Executor>
     <StateContent>
        <NodeName> Translate </NodeName>
        <Value> 3.4 5.6 4.6 </Value>
     </StateContent>
     <TimeStamp> 05:12:04 </TimeStamp>
  </Event>
```

Figure 4. Event Format using XML syntax

The sub-element of <Content> tag is used to describe the node name and value of VRML, which should be changed by this event. Events using XML syntax can be extended through adding event tag according to each application applied notification system, and enable event transmission between applications for interoperability of result in cooperative work. And building database of log data described in XML can be applied for analysis of the propensity to consume and the shopping route pattern in virtual shopping mall, analysis of study attitude of students in virtual class, the maintenance of a course of working in cooperative work, and so on.

3.2 Notifer

The designed Notifier consists of Converter and Filter. Converter changes events, which are created in external services of other VR environment, to XML. Filter reduces the amount of events by filtering.

If Notifier receives events from publisher, it doesn't transmit an event to subscribers at once. Events are transmitted to subscribers after these events pass through Converter and Filter. Figure 5 shows the operation of XML Converter, the registration of filtering and the applying point of Converter and Filter during processing of event notification.

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If events are created in other VR environment, Converter must change events to XML-form to interact with the system of other VR environment. Filter performs events filtering though examining the events that are registered by subscribers, and then transmits the filtered events to subscribers. At this time, Notifier knows the propagation range of event through accessing to VR environment server that events were generated in advance.

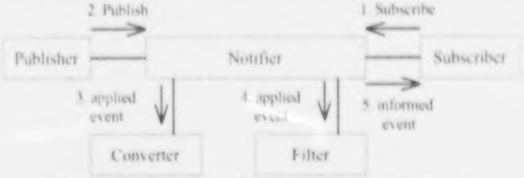


Figure 5. Event Notifier Collaboration Diagram

The registered Filter separates the default filter and the personalized filter. The default filter is applied by server (or controller) which manages application. The personalized filter can be registered by User Interface, which are supplied in each application.

The Default Filter performs the presentation event filtering generated in virtual environment about Action Event. It can apply working rules or policies about Information Event in the case of CSCW on virtual environment. Event filtering performs not only simple filtering by user request but also presentation event filtering about massive events for presentation in virtual environment. So event filtering has the benefit of reducing the amount of events for propagation in virtual environment.

The personalized filter is used to apply Human-readable event and user's interest to event receipt. In general, the registration of behavior event is automatically filtering by system, and information event is applied for private filter based on the degree of participant's interest.

4. Experimentation

We composed VR environment in which 50 participants interact with each other in 2 sessions, to evaluate usability of the proposed notification system. We apply 3 filters, presentation filter, access right filter, and receipt Information filter, to the composed VR environment.

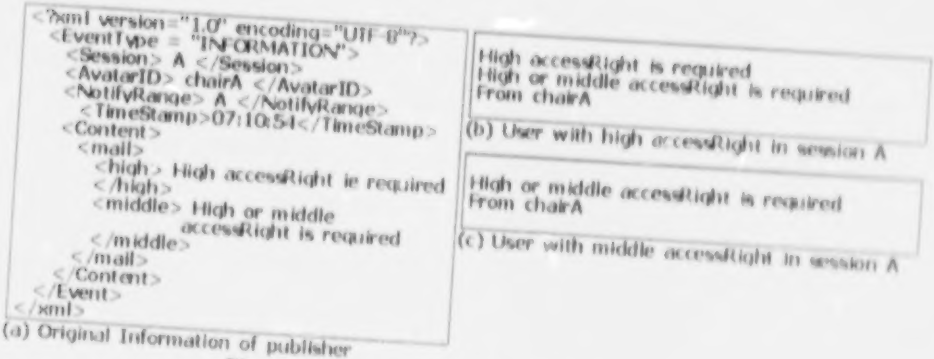
The presentation filter makes different the count of event propagation per a unit time according to distance between avatars. Notifier has a reference the value of distance between avatar from server. We assume the access right filter for access right in CSCW. The access rights of the participants in session are divided into high, middle, and low. These are applied for <tag> of XML document propagated. Notifier propagates XML document of information events propagated from server according to access rights through filtering. Finally, we applied receipt Information being able to receive events that specific avatar participating to different session generates. We assume that this filter is to support interaction with specific person in VR environment.

Table 1 shows environment applied in this experimentation.

Table 1. Parameters for VR configuration

parameter	value
size of CVE	500(m) * 500(m)
session	A,B
No. of avatars	50 per session
movement event frequency	3 (event/sec)
information event frequency	1(event/sec)
distance between avatars	A(max 30m), B(max 60m)

The access right filter propagates <high> and <middle> to "HIGH" subscriber participating to the same session, and only <middle> to "MIDDLE" subscriber about following Information events. And in the case of the participants having "LOW" rights, the filter discards the event. Figure 6(a) shows original event format, (b) and (c) is view showing according to each access right. Figure 7(a) shows the count of propagated events per each subscriber filtered by each filter among all events. Figure 7(b) shows the amount of event per each subscriber in session A filtered by each filter among all event propagation amounts.



```
<?xml version="1.0" encoding="UTF-8"?>
  <EventType = "INFORMATION">
    <Session> A </Session>
    <AvatarID> chairA </AvatarID>
    <NotifyRange> A </NotifyRange>
      <TimeStamp>07:10:54</TimeStamp>
    <Content>
      <mail>
        <high> High accessRight ie required
        </high>
        <middle> High or middle
                 accessRight is required
        </middle>
      </mail>
    </Content>
  </Event>
</xml>
```

(a) Original Information of publisher

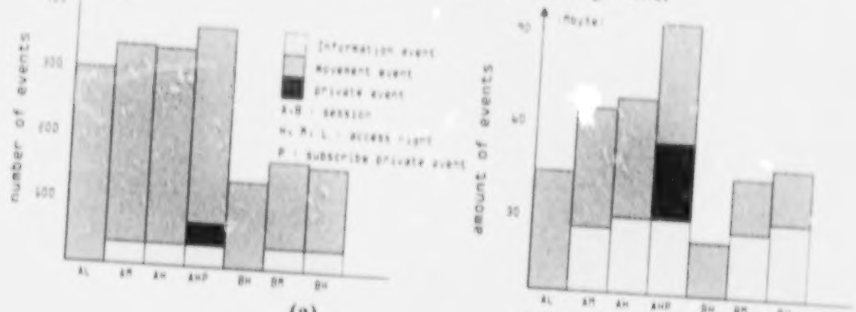
```
High accessRight is required
High or middle accessRight is required
From chairA
```

(b) User with high accessRight in session A

```
High or middle accessRight is required
From chairA
```

(c) User with middle accessRight in session A

Figure 6. The operation result of access right filter



(a) (b)

Figure 7. The result graph of event filtering

5. Conclusion

In this paper, we propose XML based event notification system in distributed virtual environments. The proposed system imports a notifier model of which event receivers can add and remove dynamically without affecting system. The system defines basic event types, and then those events express XML, which is standard of information transmission in the WWW. So, system can operate independently specific application on other environments. Therefore, it send events to receivers in accordance with registered information of participants in the filter after system convert events occurred in the every environment to XML using converter and filter. By this, we solve problem of event notification between different environments, and we also can decrease amount of transmitted events through filtering. In addition to, we increase effectiveness because system stores occurred event log data and operates filtering and retrieval of event using XML.

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Creating corporate knowledge with the PADDLE system

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Abstract: The integration of dispersed knowledge available in an organization is often referred to as corporate knowledge. The corporate knowledge of an organization can be built up, shared and maintained most efficiently if modern Internet technologies are applied by knowledge workers. As different knowledge workers have different perspectives on corporate knowledge, customization concepts are needed to tailor knowledge objects according to different needs. Additionally, the acceptance of the corporate knowledge depends mainly on the quality of the knowledge stored therein. Against this background this paper presents concepts to create corporate knowledge, to customize it according to different requirements and to ensure a high level of quality. These concepts and their implementation are discussed in the context of the PADDLE system.

1. Introduction

The crucial insight that has made knowledge management important is that the value of an organization does not depend only on the material assets of the organization (like buildings and machinery), but also on the often very dispersed knowledge “inside the heads”. The coherent integration of such dispersed knowledge in an organization is often referred to as corporate knowledge. Corporate knowledge may relate to problem solving expertise, project experiences, human resources management, lessons learned, and design issues etc. Some companies already openly acknowledge the importance of corporate knowledge by producing not just "financial balance sheets" but also "knowledge balance sheets": up to 80% of the value of an organization may be comprised of corporate knowledge rather than material assets (Murray et al. 1999). Once this crucial fact is accepted it is obvious that organizations must make sure that corporate knowledge is nurtured, protected, archived and increased as much as possible. Since this is a very complex process, systematic strategies are required. For example, according to (Skyrme et al. 1997), the development of the intellectual assets of an organization consists of six steps: Business strategy to determine which role knowledge has for strategic decisions in a company; analysis of competitors which includes an analysis of the knowledge the competitors have; knowledge classification to structure the corporate knowledge according to the knowledge of an organization’s employees; knowledge assessment to assess the value of the knowledge in an organization and to assess the costs for maintaining and extending this knowledge; investments to close gaps in an organization’s knowledge; and portfolio management to make transparent which knowledge is used at present, which knowledge will be used in the future and which knowledge is obsolete.

The complete spectrum of knowledge management activities is difficult to automate (Borghoff et al. 1997) but Information technology as an enabling technology can support specific facets of knowledge management. Corporate knowledge is one such specific facet. It can only be built up and maintained if the knowledge workers (i.e. key people responsible for the total organizational knowledge-creation process at the corporate level) make available their knowledge to their colleagues in an organization-wide knowledge base. Such a corporate knowledge base will only be used, if it can be tailored to different requirements and if a certain degree of quality is assured. This paper presents the approach taken in the context of the PADDLE system (Personal ADaptable Digital Library Environment) to support knowledge workers in extending a corporate knowledge base with their own knowledge. Beyond this we also show how knowledge workers can build up and maintain their personal knowledge space. Finally, our approach also includes a quality assurance component to ensure that only high-quality and reliable knowledge is added to the knowledge base. The remainder of the paper is structured as follows: Section 2 briefly introduces the PADDLE system. Section 3 introduces our approach to build up a corporate knowledge base which can be tailored to personal knowledge spaces. Concepts for the quality assurance component and a prototype implementation are addressed in Section 4. The paper is concluded in Section 5 with a brief look at future research directions.

2. PADDLE at a glance

Originally, the PADDLE prototype system was developed as a digital library environment for knowledge workers. Currently, the system is extended by specific knowledge management components. PADDLE offers its users a broad variety of customization and personalization features for the information resources accessible by the system (Hicks et al. 1999; Tochtermann et al. 1999). The primary characteristic of PADDLE is that the underlying approach for customization and personalization is metadata based (metadata is data about data and well known from digital catalogs). The use of metadata to support customization was motivated by its ability to exist and be maintained completely independent of the data to which it refers. This allows users or user groups to apply their personal adaptations to information resources without affecting the information resource itself.

Currently two different remote data systems are connected to PADDLE. Together they provide over 2,000 Microsoft Office documents and about 100,000 HTML documents. At a glance, the following possibilities exist to adapt the information resources of almost any Internet based remote system.

1. Personalization of metadata: Many information resources on the Internet have metadata which further describe the resources. PADDLE allows its users to adapt existing metadata to their personal needs. This includes the ability to hide and rename metadata fields as well as to add new metadata fields with new values (e.g. a new metadata field "geographical relationship" with the value "sun50.faw.uni-ulm.de" can be added to describe that a resource is located on the machine named sun50.faw.uni-ulm.de). Also, the values of existing metadata fields can be changed.

2. Personalization of search forms: Users can design personal search forms to enable them to include personalized metadata fields and values in the search process.

3. Personal working spaces: Users can store their personalizations in personal working spaces. The working spaces can be made accessible not only for single users but also for user groups.

A detailed technical description of the PADDLE system can be found in (Hicks et al. 1999).

3. The PADDLE environment for creating corporate knowledge

To build up a corporate knowledge base a shift in the paradigm of using Internet information systems must take place. Today, knowledge workers are mostly "passive" users of a system, that is, they can access, download and read resources but they can hardly add new ones or adapt existing resources to their own or a group's needs. Relevant studies in knowledge and information management have revealed that value-added services for knowledge management should include specialized knowledge spaces which serve specific needs of specific knowledge workers (e.g., to extend corporate knowledge) (Schatz et al. 1998). While adapting resources is already supported by the PADDLE system, a component for adding new resources to create a corporate knowledge base has not yet been completely developed. A corporate knowledge base can be built up in a totally unstructured way, i.e., by capturing information in different layouts and formats and recording all of the practices of an organization. Even though such an approach will be very inexpensive, it can also generate a lot of irrelevant and unstructured information. Later on the need arises to filter irrelevant from relevant information resources, to unify the layout according to the thematic areas to which an information resource belongs, to structure the information resources, etc. (Buckingham Shum 1997). In PADDLE a different approach is taken. The idea in PADDLE is to provide an environment which supports a systematic and structured way for building a corporate knowledge base. Even though an organization has to spend more time on the development in this environment, it will pay off soon as no re-organization or optimization of the corporate knowledge will be required later on.

The approach for building corporate knowledge with PADDLE covers three aspects. Firstly, an organization can differentiate between different types of knowledge objects they want to make available in their corporate knowledge base. The types for knowledge objects may include reports, product descriptions, meeting minutes, project reports, work practices etc. Secondly, an organization has to categorize the user groups working with the knowledge base. This is of particular importance as different knowledge workers need different views on the knowledge base. In this context the personalization and customization concepts of PADDLE play an important role. Thirdly, for each type of knowledge and each group of users templates are required which support the knowledge workers in preparing in a coherent way the knowledge they want to add to the knowledge base.

In the core system of PADDLE two remote data systems are integrated. Each these systems contains information from professional content providers. With the possibility to add new knowledge objects to the system the question about where to store this knowledge arose. One approach is to put new knowledge objects in context with already existing resources. The following drawbacks restrained us from pursuing this idea: putting new knowledge in context with already existing resources requires write access to the remote data sources - this is very much against the PADDLE philosophy which says that every remote data system should be treated as a black box (Tochtermann et al. 1999). In addition, an update of the remote data systems by the content providers would have caused many problems in keeping the knowledge space consistent. For example, an update may change or even delete the context of knowledge objects added by the knowledge workers. The resulting situation might be one of chaos where dangling knowledge objects have to be assigned to new contexts. Therefore, we have chosen a different approach: all knowledge objects are stored in a separate database which is completely under control of the PADDLE system and completely independent from the other remote data systems.

In order to allow users to put their knowledge objects in context with already existing resources we provide the concept of profiles. A profile is a structured collection of resources and knowledge objects which have something in common (e.g., they address the same topic, they are needed to perform a specific task etc.). The PADDLE system distinguishes between public and private profiles. Public profiles can be accessed and used by every knowledge worker of an organization. However, write access to these profiles is only granted to authorized knowledge workers. Knowledge workers can create and maintain their private profiles which are not accessible for other knowledge workers in an organization. Private profiles allow knowledge workers to create their personnel knowledge space in which they can compile not only resources from the remote data system and knowledge objects from an organization's knowledge base but also knowledge objects of any type from their local file system. The following figure depicts this idea. On the left the profile explorer is displayed. It contains all private profiles (e.g., "Climate Change" and "Kyoto Protocol"; light gray in the upper part) of a knowledge worker and all public profiles (e.g., "Climate", "Mobility and Transport" etc.; dark gray in the lower part) of the system. Unlike public profiles, private profile can contain knowledge objects from the local file (e.g., "CO2 Emission" in the private profile "Climate Change"). To easily distinguish between knowledge objects from a remote data system and those from a local file system different icons are used.

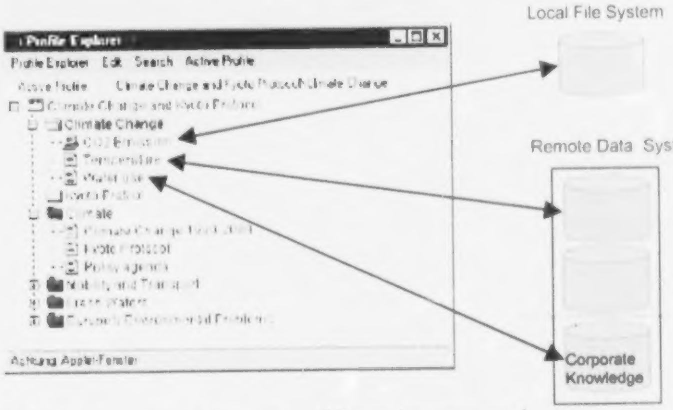

Figure 1: Public and private profiles.

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Note, that all customization features provided by the PADDLE system (Tochtermann et al. 1999) can be applied to knowledge objects in profiles. Additionally, the PADDLE concept of working space has been extended to offer a very flexible environment for customizations. Each customization of knowledge objects in profiles is valid in the context of only one working space. This makes it possible to apply different customizations of the same knowledge objects in different working spaces.

Even though the differentiation between private and public profiles match very well the basic requirements of the knowledge workers, we encountered another challenge primarily concerning the public profiles. Knowledge objects can be very rich in content (e.g., a product description). Since knowledge workers often only need some parts of a knowledge object to perform their specific task, this bears the risk that knowledge workers get overloaded by too much information and knowledge they do not need. One solution to tackle this problem is to split a knowledge object into several "smaller" knowledge objects according to the different groups of knowledge workers. As a result, the number of knowledge objects would increase dramatically. Also, the togetherness of these "small" knowledge objects has to be provided, which in turn requires further structuring concepts. The solution we have chosen is based on the PADDLE approach to support personalization and customization. All knowledge objects (except for those in the remote data systems) are represented in XML. Different XSL style sheets are used to adapt a knowledge object "on the fly" to the specific needs of a group of knowledge workers. The following figure depicts this idea. The PADDLE middleware component provides different XSL style sheets for different groups of knowledge workers. Whenever a knowledge worker of a certain group of knowledge workers accesses a knowledge object, the XSL style sheets provided for this group customizes the knowledge object "on the fly" according to specific needs of this group. With this approach we can assure that knowledge workers are always accommodated with those parts of a knowledge object which are relevant for their tasks.

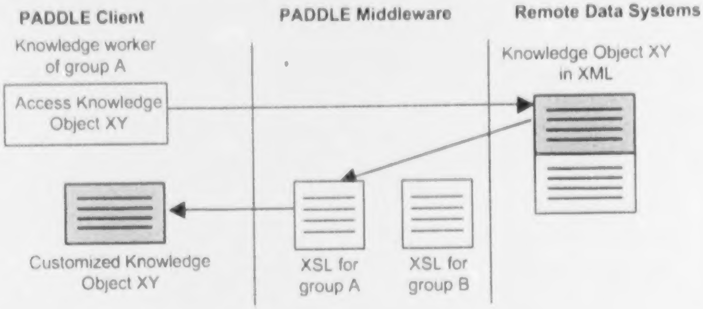
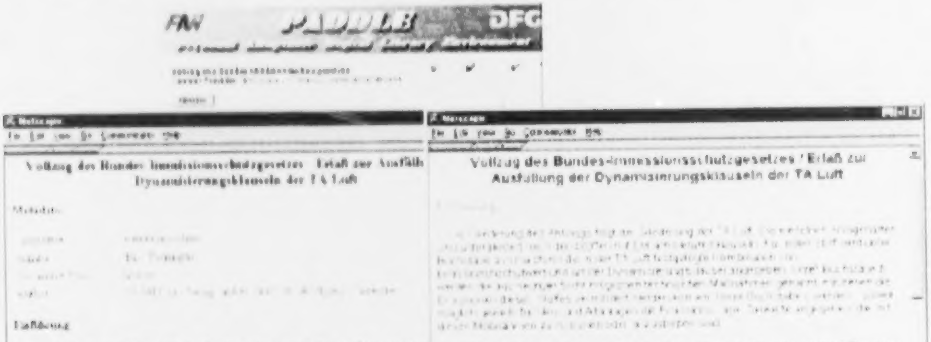

PADDLE Client
PADDLE Middleware
Remote Data Systems
Knowledge worker of group A
Access Knowledge Object XY
Knowledge Object XY in XML
Customized Knowledge Object XY
XSL for group A
XSL for group B

Figure 2: Customization of Knowledge Objects using XML and XSL

Figure 3 shows that different layouts and contents of a knowledge object can be chosen depending on the applied customization. The two windows in the lower part display the same document, however, with different customizations applied to it. Obviously the layout is different. In addition, the customization on the right does not provide the knowledge worker with the metadata which exist for this document (c.f. document on the left).



Vollzug des Bundes-Immissionsschutzgesetzes / Erlaß zur Ausfüllung der Dynamisierungsklauseln der TA Luft

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Figure 3: Customized knowledge objects

Technically, Java servlets of the PADDLE middleware are used for the customization. Using pre-defined XSL style sheets, the servlets generate different HTML documents on the basis of existing XML documents.

4. Quality Assurance

The level of quality of the knowledge in a corporate knowledge base directly influences the level of acceptance to use the corporate knowledge. Therefore, before knowledge can be made available widely, it should undergo a quality assurance process.

In our approach the quality assurance process is part of a linear workflow which serves the purpose to disseminate, review, edit and release knowledge objects to a predefined group of users. The first step of the quality assurance process ensures that the knowledge objects can be searched for effectively. This formal check can be passed if all metadata of a knowledge object are defined according to a pre-defined data type definition. In addition, the plausibility of the defined metadata is checked, that is if the value of a metadata field belongs to a pre-defined data type. While the first step of quality assurance can be done automatically, the second step of quality assurance, the content check, requires intellectual assessments of experts and, thus, cannot be carried out automatically. This check of the quality of the content of a knowledge object ensures that the resources meet the quality standards of an organization.

As to the content, we differentiate between two quality certificates (restricted and public) of the knowledge objects. The quality certificate is defined by the users who want to add knowledge objects to the corporate knowledge base. The certificate determines if a knowledge object has to go through both steps or only the first step of the quality assurance process. The certificate also determines how widely a knowledge object is made available. Knowledge objects with a restricted quality certificate have to pass the first step of the quality assurance process only; this ensures that they have well-defined metadata and, thus, can be searched for effectively. Since no check against the quality of the content is carried out, such knowledge objects are made available only in defined areas of the knowledge base to which selected knowledge workers have access. The public quality certificate requires that a knowledge object goes through both steps of the quality assurance process. Once they pass these steps they are made available to all users of the corporate knowledge. The differentiation between these two types of certificates has proven valuable for sharing of knowledge objects which exist in a premature or preliminary version only. In organizations, such knowledge objects are of great importance for well-defined groups of users (e.g., strategic planning group) which have to rely on latest information about new trends, new legislation etc.

Finally, users can assign priorities to the knowledge objects before they enter the quality assurance process. Priorities are of particular importance for the second step of the quality assurance process as they provide the experts a rough order in which they should assess the quality of the content of an information resource. The following figure depicts the main steps of the quality assurance process.

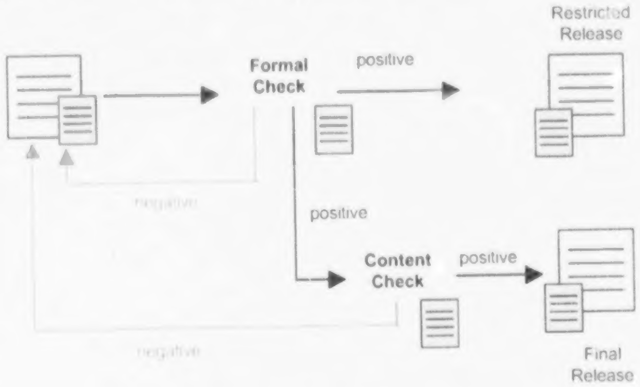

Figure 4: Quality assurance process

Technically, the quality assurance component capitalizes on XML and DTD defined for different types of knowledge objects. The formal check verifies if the metadata of knowledge objects are specified according to a pre-defined DTD. For example, this includes if all relevant metadata fields have meaningful values. Any complaints why a knowledge object did not pass the checks are recorded in a report (shaded rectangle in figure 4). This report is a separate document but linked to the respective knowledge object.

5. Outlook

Currently, the knowledge management component of PADDLE focuses on explicit knowledge but not tacit knowledge. While explicit knowledge can be captured and codified, tacit knowledge is knowledge which cannot be easily articulated because we are not aware of it. The idea to capture tacit knowledge with the PADDLE system is based on the observation that profiles and customizations of knowledge objects represent some of a knowledge worker's tacit knowledge (Stenmark 1999). For example, the way in which knowledge objects are put in context with each other, how knowledge objects are structured in a profile, how and in which working space they are customized etc. reflects tacit knowledge of a knowledge worker which we want to exploit for automatically structuring the corporate knowledge base. Also, the quality assurance component needs further improvements. The idea is to develop a strategy that can include several experts in specific fields in the quality assurance process of one knowledge object. This is revealed to be of great importance particularly for knowledge objects which cover a broad range of topics. Finally, the retrieval of knowledge objects will be improved through the integration of a GIS-based geographical search component (Tochtermann et al. 2000).

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Enhancing Information Portals with Internet-based GIS

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Abstract: The advancement of Internet technologies and geographical information systems (GIS) have opened up new opportunities for the application of Internet-based GIS in the context of information and knowledge management. Based on the observation that almost every type of information resource has some geographical relationship this paper introduces how GIS can be used as search components in information portals to search for multi-referenced information resources (i.e., resources with several relationships such as temporal, thematic and geographical relationships). In addition, the applicability of geographical maps for displaying search results containing large numbers of hits is presented. Finally, the system architecture of our current prototype is described which allows the integration of arbitrary holdings with GIS.

1. Introduction

It is expected that the knowledge of the emerging Information Society doubles every five to ten years. The information, the knowledge is based on, will be stored in repositories distributed all over the world. Even though it is expected that each small community will maintain a collection of their own knowledge [Schatz et al. 1999], this collection will not be provided by a single encapsulated system which stores all the information available. A reason for this is that the information will vary in two ways: (a) technically the information will be different in layout, format and size and (b) with regard to the content information will exist at different levels of abstraction. Due to this, the knowledge of each community will be distributed among different information systems each of which matching best the specific characteristics of the information stored therein. In order to support users best in retrieving information in such distributed information spaces single points of access have proven beneficial. Such single points of access are often referred to as information portals.

A common understanding of an information portal is that it provides "knowledge workers with a secure, single point of exchange of relevant information, both structured and unstructured, both inside and outside of the organization through a standard Web browser interface" [Hyperwave 1999]. The functionalities of information portals typically comprise a publishing component, a retrieval component and a collaboration component. The publishing component allows authorized users to enrich the information space by contributing content to it. From the treasure of information stored in the information space, a retrieval component supports users in retrieving the information which is most relevant for their current task. The collaboration component facilitates the collaboration between the members of a knowledge community. Collaboration support may reach from simple asynchronous features such as email to full-featured synchronous tools such as video supported chat sessions.

While publishing and collaboration tools are discussed in another paper of our group [Tochtermann et al. 2000] this paper focuses on search and retrieval tools for information portals. Most of the research in this field has been conducted in the area of digital libraries. In this context it is argued that powerful search, browsing and indexing tools cannot obviate the need for metadata [Levy 1995]. With the Dublin Core [Weibel 1999], a well accepted standard exists for defining a minimal set of metadata which can be used to catalog an information resource. Among the set of metadata there are elements for describing the title, the author, subject and different kinds of relationships of an information resource. In addition to thematic and temporal relationships geographical relationships will be playing a increasingly important role in the future.

A geographical relationship is reference to the location of an object and is used to describe the geographical characteristics of the intellectual content of this object. It refers to a physical region using geographical names or coordinates (e.g., longitude and latitude). Often, a geographical relationship is associated only with typical geo-data such as environmental data, remote sensing data and images from satellites and aircraft etc. But indeed, almost every type of information resource has a geographical reference. For instance, regulations can be geo-indexed with the country or state they are valid in, scientific papers can be geo-indexed with a conference location where they were presented, files can be geo-indexed with the location of the server they are stored on etc. To define a geographical relationship for a query, search engines and digital catalogs commonly provide textual query interfaces, that is users have to type in the name of a region (e.g., "Texas") to define the geographical relationship of the resources to be searched for. Similar to this, the results of a query are displayed as a textual list of links pointing to the resources matching the query. In special cases (e.g., Z39.50 compliant query languages) it is required that not only sophisticated but also casual users have to be familiar with the syntax of the query language in general and with the geographical names the system "understands" in particular [Witten et al. 1999]. To support users, sometimes either thesauri or gazetteers (i.e., geospatial dictionaries of geographical names) are integrated in a system [ADL 2000]. Finally, many search engines and digital catalogs allow users to formulate queries which yield an empty result, a situation which can have a negative impact on the user acceptance of a system.

Four conclusions can be drawn from this brief survey: (a) currently, geographical relationships are not sufficiently exploited for "non-geo-data", (b) instead of textual interfaces, be it for formulating queries or for displaying results, digital interactive maps hold a great potential to significantly improve user interfaces for using complex document holdings, (c) the potential of geographical relationships to improve information mediation is often underestimated, and (d) to reach a high user acceptance systems have to be designed in a way which guides users to formulate queries leading to non-empty results. These observations build the starting point for our research: to investigate geographical search components as new interactive information mediators for information portals.

The paper is structured as follows: Section 2 provides solutions to overcome existing shortcomings with using multiple relationships in queries. Section 3 then presents how the results of queries can be displayed in a way which takes into account the geographical relationship of the retrieved resources. Finally, Section 4 gives an overview of the system architecture of our prototype before the paper closes with a brief conclusion and outlook in Section 5.

2. Using geographical maps to search for multi-referenced information resources

In the fields of environmental informatics, multimedia cartography [Cartwright et al. 1999] to mention just a few lot of research has been conducted to apply geographic relationships for searching in environmental data and geo-data. However, only little experience exists in how geographical references can be applied for any type of data which has some geographical reference. Existing sophisticated digital catalogs provide users with possibilities to define textual queries which include temporal, thematic and geographical relationships [Tochtermann et al. 1997], [ADL 2000]. In advanced systems users can select geo-objects on a map to define the geographical relationship but all too often only textual interfaces are provided. In a separate component users define other relationships the resources of interest have to match. The drawback of this approach is that for multi-referenced queries (i.e., queries in which many different relationships such as thematic, temporal and geographical relationships are applied) the query interface is often a mixture of an interactive, graphical interface and a textual interface. A real added value can be provided, if search components consisted of one interface which intuitively supports the formulation of multi-referenced queries.

So-called smart maps provide such an added value. The concept of smart maps is defined as a concept of visualization of one or more relationships between information resources and places on a map [Rose et al. 1999]. For example, the description of a forest can be correlated to a region on a map representing the physical location of the forest. This reference is animated (e.g., in form of a popup menu) by a sensitive area on the map which appears when the users moves a pointing device over the map and enters the region. A popup menu can show users the titles of all information resources linked to the respective region. Selecting a title will retrieve the information resource. The implementation of smart maps requires to link all relevant information related to a named region on the map of interest. There are two drawbacks of the approach described: Firstly, often smart maps do not use an Internet-based geographical information system (GIS) to relate an information resource automatically (e.g., based on its geographical relationship) to a location on a map. This means whenever a new resource is added to the information space an explicit assignment of the resource to a location on a map is required. Secondly, it is not obvious for users where sensitive areas are located on the map. As a result, before searching the information of interest, users have to search the locations from which they can access the information.

Our idea is to capitalize on smart maps and to apply geographical maps with an underlying GIS to search for multi-referenced information resources (c.f. figure 1):

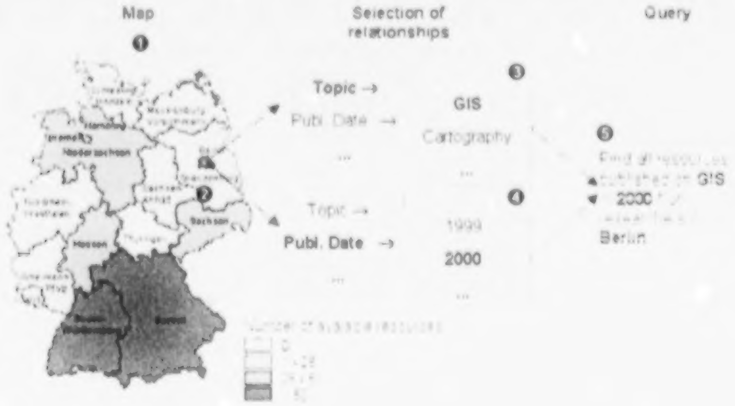

Figure 1: Using maps to formulate multi-referenced queries

In a first step users ask the system to highlight all geo-objects on a map to which information resources exist which are indexed with geo-objects on the map (❶). In a second step, a technique referred to as geographical access is applied [Kraak et al. 1997]. This means that users have to specify the geographical relationship of their query by clicking on a point or on a geo-object by defining a rectangular geometry etc. (❷). After users have selected a geo-object, they get access to a subject tree containing all thematic relationships of information resources which are indexed with the respective geo-reference. Users select one or more entries in the subject tree to define the thematic relationship for their query (❸). The same approach can be applied for other relationships such as time (❹). At the end of this process a query has been formulated (❺) which can then be used for searching for information resources. In this approach the maps have a certain degree of intelligence in that each geo-object "knows" which thematic and other relationships information resources have which are indexed with this geo-object.

To further support users in selecting a geographical relationship different maps with different scales are provided. This ensures that users can start their searches with a large scaled map (i.e., a map with a low the level of detail) on which geo-objects can only be selected at a low level of detail (e.g., only States can be selected but counties cannot). Still, as users become familiar with the system they can change the scale of maps at their will to restrict their queries to more precise geographical relationships.

Presenting footprints on maps is a well-known concept in literature [Larson 1995]. The idea is to provide footprints as hypermedia links on a map. Selection of a footprint brings up information resources referenced by the link. The problem with this approach is that if all footprints are shown simultaneously the map may disappear entirely. However, we have taken up the idea of footprints in another sense. Many information portals allow users to store their queries for later purposes [Hyperwave 1999]. Similar to this, we visualize stored queries as footprints on maps. Whenever users select a footprint, the query can be revised before it will be sent to the system which returns the corresponding information resources. To avoid the problem that all footprints from all users overload the maps we allow users to design their personal maps with their personal footprints. This is an important contribution to a new emerging research area: personalization and customization in Internet based information systems [Tochtermann et al. 1999].

3. Using geographical maps to display multi-referenced search results

While the previous Section introduced our concept of how multi-referenced information resources can be searched for using geographical maps, this Section shows how huge numbers of hits can be displayed on maps.

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Instead of a list of links pointing to the resources found, our approach is to represent hits by graphical symbols on a map.

The idea is based on the observation that each information resource found by a query has a geographical relationship. This is a mandatory pre-requisite to represent a resource by a graphical symbol on the location of a map which corresponds to the resource's geographical reference. By clicking on a symbol, users can access the respective resource (c.f., figure 2 on the left). However, experimental tests revealed that this initial idea has two shortcomings: Firstly, if too many resources were found a map easily becomes overloaded by placing too many symbols on it. Secondly, a symbol does not provide further information about a resource even though this information exists. For instance, if two different thematic relationships (e.g., GIS and cartography) were defined in the query, a user might be interested in browsing first through resources which are related to GIS.

To overcome these limitations we provide users with the following concept: To reduce the complexity, we introduce a higher level of abstraction in that graphical symbols do not represent the resources themselves but clusters of resources. Resources belong to the same cluster if they are indexed with the same value for a relationship (e.g., GIS for the thematic relationship). Currently, clusters can only be based on one relationship (e.g., thematic relationship) even though more flexibility is desired for structuring results of complex queries. Clicking on a cluster symbol pops up a list of links to resources; selecting a link in this list brings up the resource. The concept of clusters is displayed on the right of figure 2.

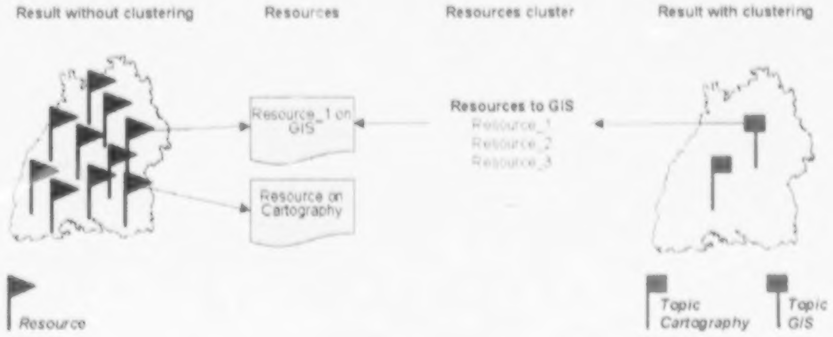

Figure 2: Visualization of search results without (on the left) and with (on the right) clustering of hits

4. Technical aspects

During our prototype development we encountered some technical challenges. The first one was how to store the geo-objects. For storage purposes of geo-objects we are using a full-featured Internet-compliant geographical information system (GIS) [Geotask 2000]. The main advantage of a GIS is that topological relationships between geo-objects can easily be computed by standard GIS functionality. Implicit topological relationships between geo-objects can be exploited for geographical indexing of and searching for resources. For example, it allows users to search for resources which are related to a specific region or to all neighboring regions without explicitly naming the neighboring regions. Among the typical relationships which can automatically be computed by a GIS are *encloses*, *is enclosed by*, *is adjacent to*, and *overlaps*.

With the decision to apply a GIS in the system architecture we encountered a second challenge, which was how to model the relationship between the geo-objects and the other relationships of the indexed information resources. Since each GIS uses some kind of a database for storing the geo-objects a first thought was to store all relationships of the information resources in this database. This approach, however, makes it impossible to use arbitrary documents holdings as their metadata always have to be transferred to the GIS database. As a consequence, maintaining the metadata in the GIS database becomes quiet difficult as content providers are not willing to change their strategic database platforms for a GIS database. Due to this, we have chosen a solution which clearly separates between the maintenance and storage of geo-objects from the maintenance and storage of other metadata of information resources. Therefore, our architecture is based on two components [Schwartz et al. 1999]: the GIS for geo-objects and an arbitrary system for storing the metadata of the information resources. These two system

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components are connected to one another by a many-to-many relationship between geo-objects and metadata of an information resource. The many-to-many relationship is required as an information resource can be related to more than one geographical region (e.g., an environmental law can be valid in several regions) and vice versa, many different information resources can be geo-indexed with the same geographical region (e.g., in one region several different environmental laws can be valid). The relationship is modeled by unique identifiers for geo-objects.

This architectural design is sketched in figure 3. For the sake of simplicity the figure only displays a metadata system on the right, but it is worth mentioning that it does not matter whether the metadata is stored together with the information resources, such as in the Alexandria Digital Library [ADL 2000], or in a separate metadata system such as in the GEIN system [Tochtermann et al. 1997].

Figure 3 illustrates the main data-flows between the different system components: If users submit a query with a geo-reference, the client first consults the GIS system (❶). The GIS system returns all identifiers of geo-objects matching the query (❷). In a next step the client consults the database containing the metadata (❸). In this database all information resources are identified which have a geo-reference represented by the geo-object identifiers yielded by the GIS. In addition, the information resources to be returned (❹) have to match all other relationships defined in the query.

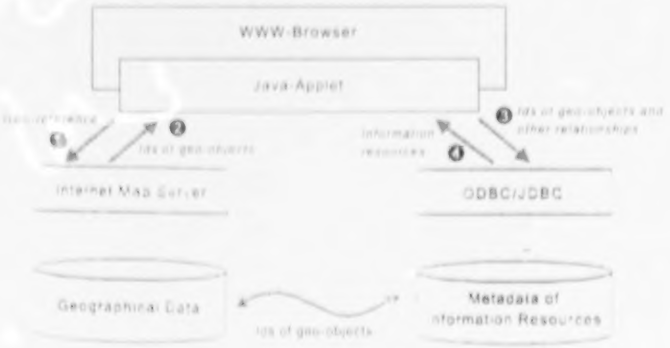

Figure 3: System architecture

5. Conclusion and outlook

In this paper we presented our ideas of how multi-referenced queries can be formulated using geographical maps and how hits matching such queries can be displayed in a structured way on maps. The advantages of the approach presented are manifold: Map-based user query interfaces are more intuitive compared to textual user interfaces where users have to enter geo-graphical names to define an geographical relationship. The search results can be clustered and displayed in a structured way on maps. The use of a GIS for managing geographical relationships facilitates the cataloging of information resources as implicit topological relationships, such as is adjacent to, can be computed on demand by the system and, thus, do not have to be stored explicitly. In addition, users can exploit these topological relationships in their queries. The architectural design of our prototype allows the integration of arbitrary information and database systems.

The next steps of our research concern the integration of the prototype system in the PADDLE system [Tochtermann et al. 1999], [Tochtermann et al. 2000]. This will be accompanied with the development of personalization and customization concepts for geo-objects. The idea is that according to the PADDLE philosophy users are provided with possibilities to design maps with personal geo-objects. For example, this includes functionality to define new geo-objects based on existing ones (e.g., users can define a new geo-object "Southern States" which is a compound geo-object based on the geo-objects "Texas", "New Mexico" and "Louisiana").

In addition, we also want to develop mechanisms which allow users to define complex clusters. Unlike in the current prototype, which supports only clusters according to one relationship (e.g., thematic), complex clusters can be based on many different relationships (e.g., thematic and temporal). This will be of great value for structuring

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results of complex queries in which multiple relationships and multiple values for each relationships are used (e.g., for results of the query "Find all resources published on GIS or multimedia cartography between 1995 and 2000" a complex cluster could represent all resources related to GIS and the year 1999).

Finally, we are planning to incorporate NewsMaps as a new concept for displaying complex holdings [NewsMap 2000]. NewsMaps look like topographical maps of mountains and valleys. The concept of layout is simple: documents with similar content are placed close together. Peaks (valleys) appear where there is a high (low) concentration of closely related documents. If documents exist which are not at all related to other documents islands appear.

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MPML: A Multimodal Presentation Markup Language with Character Agent Control Functions

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Abstract: As a new style of effective information presentations and a new multimodal information content production on the World Wide Web (WWW), multimodal presentation using interactive life-like agents with verbal conversation capability appears to be very attractive and important. For this purpose, we have developed Multimodal Presentation Markup Language (MPML), which allows many users to write attractive multimodal presentations easily. MPML is a markup language conformed to Extensible Markup Language (XML). It supports functions for controlling verbal presentation and agent behavior. In this paper, we present the specification, related tools, and application of MPML when used as a tool for composing multimodal presentations on the WWW.

Introduction

Providing attractive and effective information to all ranges of audiences becomes an important matter to the information providers. We consider that using character agent to provide multimodal presentation, as a new form of presentation, is attractive and significant. Currently available presentation tools provide explanation screens and displaying features for human presenter to manipulate and deliver the presentation by voice and actions. This is comfortable for the audiences to perceive compared to the plain document. In this paper, we propose a multimodal presentation by character agent instead of human presenter. The effort has been made to provide the character agent with various features so that it can deliver the presentation without intervention of human presenter, which is a desirable feature for contents on the WWW.

Nowadays, the developments in character agent system and voice recognition/synthesis are very sophisticated so that such a presentation can be made practical. However, it is subtle and tedious task to make content like that because of the specific features including script language in each system. In order to promote the use of such content, it is necessary to innovate a script language that works together with HTML and simply enough for the content builders to incorporate into their pages.

Presentation Agent

At present, not only text and graphics can be used in WWW pages, we may compose multimedia presentation by putting animation, music and voices on the pages. Such scenario is emerging quickly. The content makers can create their presentation and provide it on the WWW so that everyone can access the presentation anytime. (Fig. 1 (b))

Even that seems to be quite fascinating, it is only one-way communication. The users may use mouse to jump from page to page or close the window, which are bound for page hopping and session ending. Moreover, such fashion is different from the presentation performed by human as shown in (Fig. 1(a)). The audiences cannot feedback their feeling to the content makers.

We considered implementation of a character agent system, which enables us to provide fascinating multimodal information content and presentation on the WWW. Some examples of currently available multimodal anthropomorphic agent interface are the TOSBURG II by Toshiba (Takebayashi 94), the system at Sony CSL

(Nagao 94) and the system at Electrotechnical Laboratory (Hasegawa 97). At the moment, there are many research works on automatic presentation such as Virtual Human Presenter at University of Pennsylvania, and WebPersona, which have WWW capability at The German Research Center for Artificial Intelligence (DFKI).

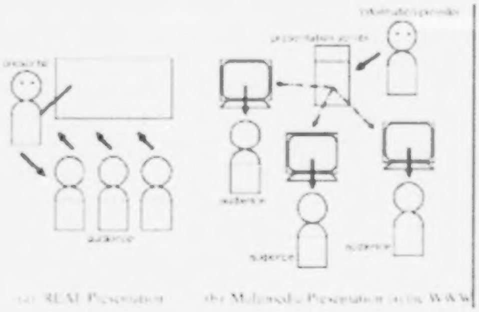
presenter
audience
information provider
presentation server
audience
audience
audience
(a) REAL Presentation
(b) Multimedia Presentation on the WWW

Figure 1: Styles of Presentation

Character Agent based Presentation on the WWW

Using character agents to present contents on the WWW is a promising way to make the contents attractive and promote widespread use of multimodal contents as shown in (Fig. 2).

In order to make use of presentation on the WWW by character agents, an important issue is that we should have a scripting language, which is easy to compose and does not depend on each character agent system. In this paper we have designed and developed Multimodal Presentation Markup Language (MPML) as the first step to achieve the objectives described above.

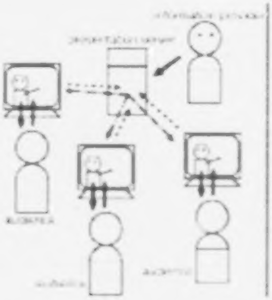
information provider
presentation server
audience
audience
audience

Figure 2: Multimodal Presentation by Character Agent on the WWW

Features of Multimodal Presentation Markup Language MPML

MPML is a markup language, which is designed and developed to facilitate multimodal presentation by character agents. It has the following features:

- **Platform Independency**: The content builders usually need to take audiences' OS, browsers and resources into account when providing presentation on the WWW. MPML is independent to browsers or systems. Moreover, it is designed so that the contents written in MPML can be played on wide variety of tools or players.
- **Simplicity**: MPML conforms to XML (Extensible Markup Language) specification. At the present, MPML version 1.0 implements 19 tags. For those who can write HTML scripts to build web pages, they will find that writing multimodal presentation by character agents in MPML is quite simple.

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- **Media Synchronization**: Synchronization of medias such as voices, images and gestures is necessary to create an attractive presentation. On this purpose, W3C announced SMIL (Synchronized Multimedia Integration Language) (see SMIL), which is a language for controlling complex media data on the WWW in 1998. MPML implements media synchronization based on SMIL specification.
- **Controls of Character Agents**: MPML supports action controls of character agents such as greeting, pointing and explaining. Furthermore, the expression controls such as smiling and puzzled are also incorporated.
- **Controls of Interactive Presentation**: MPML also supports the use of hyperlinks. When using with voice recognition engine, it can conduct the interaction between the audience and the character agent via voice commands, which serves well as navigation along the presentation.

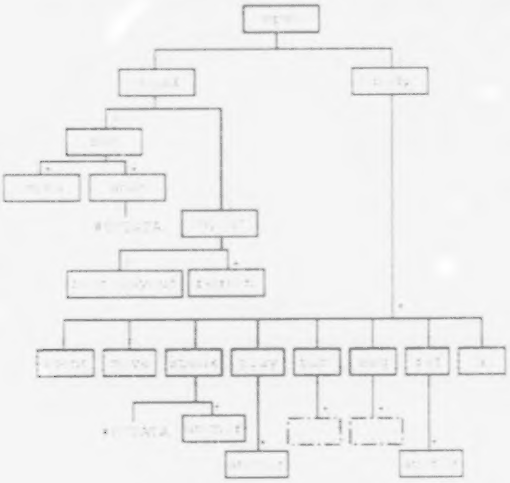

Figure 3: MPML structure tree

Specification of MPML

This section is devoted to explain the specification of MPML. The tree diagram that represents the structure of MPML document is shown in (Fig. 3). The mark "?" indicates that the tag can be omitted or used at most 1 time. The mark "*" indicates that the tag can be used any arbitrary times. The "#PCDATA" in the tree diagram represents text data. The root of all elements is the tag <mpml>, which has "id" attribute. The "id" attribute is utilized to facilitate identification of tags. Most of the tags can be assigned IDs.

Document Headers

Content builders can provide information about the presentation and layout in MPML document using the area cast by the <head>…</head>. Meta data can be provided by using tag <rec> and layout information can be provided using tag <layout>.

- **Meta Data**: Content builders can write general information about the presentation using <meta> or <abst> within tag <rec>. Tag element <meta> is an empty content tag in which information can be put as its attribute. Tag element <abst> is a content-defined tag. The contents of the tag control the layout of the presentation.
- **Layout**: The contents of tag element <layout> are the information about layout of the presentation. The contents can be arbitrary but MPML has its default layout style. The sub element can be <root-layout> or <region>. Tag element <root-layout> defines the characteristic of the root window of the presentation. Tag element <region> defines layout information for points or rectangular regions. The content builders can use one tag <region> for one region.

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Document Body

The document body cast by <body>...</body> contains the contents of the presentation. By default, the tag element <body> contains <seq>. If there is nothing specified, the actions will be sequential.

- **Agent Selection**: Tag element <agent> is used to select the character agent that performs the presentation. Tag element <move>, <speak> and <play> will refer to the agent given in tag element <agent>. The content builders can use multiple agents to perform the presentation by using <agent> to initiate agents with corresponding IDs.
- **Agent Movement**: The content builders can move character agents using tag element <move>. The agents can be moved to defined regions or points or to specified coordinates.

The content of tag element <speak> is text sentences. The players send this information to voice synthesizer engine of the character agents to make them speak. Moreover, tag element <play> can be used to play actions of character agents. MPML is capable of playing basic actions such as greeting, pointing to selected regions, and doing some actions at the same time. The attributes of each tag element are listed in (Tab. 1).

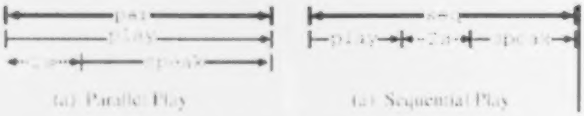
Table 1: Tag elements for agent behavior description

Tag Element	Attribute	Function
move	id	Identification
	agent	Specify id of <agent> to be moved
	region	Specify id of destination
	location	Specify coordinates of destination
	stand	Specify standing point for destination
	speed	Specify moving speed
speak	id	Identification
	agent	Specify id of <agent> to speak
	lang	Specify language to speak
	voice-type	Specify type of the voice
	speed	Specify speaking speed
	begin	Specify the time to start speaking
	end	Specify the time to stop speaking
	dur	Specify speaking duration
	alt	Specify using of message display when voice is not supported.
play	id	Identification
	agent	Specify agent to do actions
	act	Specify action content
	parts	Specify the parts to do actions
	object	Specify object id to do actions
	object-loc	Specify coordinates of the action
	degree	Specify level of actions
	speed	Specify speed of doing actions.
	begin	Specify the time to start actions
	end	Specify the time to stop actions
	dur	Specify duration of action
	track	Select to enable/disable tracking
	point-gesture	Specify hand actions when doing actions

Media Synchronization

The contents of tag element <par> will be played in parallel regardless of the orders in the list. For example, the action model shown in (Fig. 4(a)), the character agent will start speaking 2 seconds after initiated greeting.

The contents of tag element <seq> will be played sequentially according to the order written in the list. For example, the action model shown in (Fig. 4(b)), the character agent will start speaking 2 seconds after the greeting action is done.



(a) Parallel Play (a) Sequential Play

Figure 4: Models of synchronized play in MPML

Hyperlink/Presentation Controls

The content builders can control the presentation according to mouse operations or voice input by using tag element <a>. With this tag, the content builders can stop, restart the presentation, and jump among portions.

Tag element <a> can have the following attributes:

```
id, title, href, show, mode, begin,
end, dur, region, listen, lang,
key, confidence
```

The attribute mode is used to determine the control when interaction occurs. For example <a mode="jump" href="link1"> the presentation will jump to the specified link. The attribute href is similar to that of HTML, which specifies a link. The attribute show is used to control the flow of presentation when jumping to another link happened. The attribute key is used to specify the input voice commands. Together with this attribute, selection mark "|", option marks "[ ]", shortcut mark "...", priority marks "( )" are used. For example, key="...[say] (hello|hi)" the input can be either "say hello", "please hello", or "Hi". The attribute confidence is used to specify the reliability level of recognized voice commands. The attribute listen lets the character agent to wait for an input voice command, where the input can be controlled by begin, end, and dur. The attribute region specifies the region on which the specified actions take place when the mouse is clicked.

Moreover, the tag element <anchor> can be used in 2 ways as follows:

- To specify a terminal anchor on a point of time of media object or agent action.
- To specify an anchor on point of space of media object or agent action.

The content builders can jump into the middle of media object or agent's dialogue specified by <anchor> using the tag <a>. For example, if the presentation jump to the point id called "anc1" the talk will start right from that point.

```
<speak>
    This part will not be read
    if jump-started from "anc1"
    <anchor id="anc1" />
    Read from here!
</speak>
```

Presentation of alternative contents

Tag element <switch> is designed to use when the contents do not match the capability of the player. MPML enables using of multiple alternatives. The content builders can provide the contents in a variety of formats sorted by the preferable forms. Usually, text content comes the last order since text capability is likely to be the most basic feature of any players.

Sample Script

A simple MPML document can be written as shown below:

```
<mpml>
    <head>
        <layout>
            <root-layout id="root" width="800" height="600" />
            <region id="spot1" location="500, 300" />
            <region id="spot2" location="20%, 50% />
        </layout>
```

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```
        </head>
        <body>
                <ref region="root" src=http://www.miv.t.u-tokyo.ac.jp/" />
                <agent region="spot1" />
                <par>
                        <play act="point" region="spot2" />
                        <speak>
                                This is MPML Home Page!
                        </speak>
                </par>
        </body>
</mpml>
```

With the above script the presentation will be like following:
The background of the presentation will be the web page, which the URL is specified in <ref>. The default agent character will appear from the area specified by spot1. The agent will point to the area specified by spot2 and speak the content bounded by <speak> and </speak>.

Comparison with Other Markup Languages

The comparison of MPML with other markup languages (SMIL and HTML) is shown in (Tab. 2).

Table 2: Comparison of MPML with other WWW markup languages.

Scripting Function	MPML	SMIL	HTML
Web publication	Possible	Possible	Possible
Link to other URLs	Possible	Possible	Possible
Data description	Has standard form	Self defined	Basicly impossible
Layout description	Possible	Possible	Basicly impossible
Media Synchronization	Minimum features	Full features	Impossible
Agent's action description	Possible	Impossible	Impossible
Mouse Control	Possible	Possible	Possible
Voice Control	Possible	Impossible	Impossible
Text to speech	Possible	Impossible	Impossible
Current users	Very little	Few	Remarkably large
Tools	Few	About 10	A great number
Number of tags	About 20	About 20	About 80

Even all these markup languages are designed for Web publication, there are some differences. For example, since SMIL is designed mainly for media synchronization, the description of layout and timing for playing the media are strengthened in its specification. On the other side, since MPML is designed mainly for simplicity in character agent based multimodal presentation content composing, it incorporates only minimum media synchronization and layout features sufficient to perform presentation. Furthermore, due to the need of speech dialogue features, it has to incorporate voice commands and TTS (Text-To-Speech) capability.

Concluding Remarks

The MPML is a script language that facilitates the making and distributing of multimodal contents with character presenter is proposed. MPML is conforms to XML specification. At the same time, it supports media synchronization with character agents' actions and voice commands that conforms to SMIL specification. The content builders can use MPML to create multimodal presentation contents on the WWW simply by scripting with the small set of MPML tags. At the moment, only basic interactive functions, which are sufficient to the presentation aspect, are available. However the bi-directional communication between the contents and the audiences should be studied more and incorporated into the MPML specification in order to expand the application areas.

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Development of conceptual models for Internet search: A case study

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Abstract: Using the Internet to search for information is frustrating for novices. Either nothing is found or most of the retrieved information is not relevant. To help overcome this we have developed a web-based courseware module, using conceptual models based on constructivism, to teach novices how to use the Internet for searching. This paper describes the creation and evaluation of the courseware. Questionnaires and interviews were used to understand the difficulties of a group of novices. The conceptual model of the experts for the task was derived using Applied Cognitive Task Analysis (ACTA) and analogy developed to assist novices understand the expert cognitive model. The web-courseware module was evaluated using a second novice population. The outcome demonstrated that using conceptual models in learning can help novices to acquire an understanding of the search mechanism and so enable them to learn better.

Introduction

To be able to use the Internet effectively is not a trivial task. The problem is further compounded when we have to teach others to search for information on the Internet. Part of the difficulty of teaching others to use the Internet is deciding what to teach and how best to teach them. There are several overlapping knowledge domains in which users must have some conceptual knowledge to be able to successfully use the Internet to search for information. Users must possess information retrieval skills, knowledge of how the system functions, knowledge of the subject in which they are seeking information and problem-solving skills (Brandt 1997) These problems are not helped by the fact that browsing the Internet can seem different from using the 'normal' office applications on the PC. Even people who are proficient in basic computing skills and have lengthy experience of using traditional software can be confronted by many problems when using the Internet. It appears that the perception that Internet is very different hinders the transfer of appropriate knowledge from the off-line to the on-line domain. What is needed is conceptual knowledge of the Internet and the tasks that can be performed on it. How, then, can we help novices to search for relevant information effectively on the Internet?

We believe that conceptual models can be used to help novices to learn the Internet effectively in a constructivist learning environment. This paper describes the development of conceptual models using the Applied Cognitive Task Analysis (ACTA) method to teach Internet search. The conceptual models developed were integrated into a web-based courseware module designed using the Courseware Engineering Methodology (Uden 1997, 1998). Evaluation of the conceptual models was carried out by novices.

Constructivist Learning

Constructivist learning holds that learners learn new knowledge by refining to things already known or experienced. Constructivist teaching seeks to help learners to construct advanced knowledge that will support problem-solving skills and expert task performance. It is ideal for teaching a complex and ill-structured domain such as the Internet. According to constructivists, users construct knowledge about a new system by transferring and expanding existing knowledge through mental models (Brandt 1997). A mental model of a typewriter has been used to teach word processing. With a conceptual understanding of typing, novices could get past the confusion of an abstract electronic tool and relate editing to manual typing. When learners are provided with conceptual models and situated experiences that reinforce those models, their mental models will be extended and developed.

Mental Models and Conceptual Models

A mental model is developed as a user interacts with a topic. Users create new mental models to describe the topic by means of structural mapping; that is, users map the structural relations of an existing model onto the new (Gentner & Gentner 1983). The conceptual model of the topic is created by the teacher and encompasses the knowledge that is to be transferred to the learners. The conceptual model is usually represented by an analogy or metaphor. Analogy is extremely powerful because it presents a description of a topic by reference to existing knowledge held by the user. Furthermore, interaction with a topic forces the user to compare the similarities and dissimilarities between it and the analogy presented. We believe that the development of good conceptual models can help to bridge the gap that exists between novice and expert Internet users. Thus, the goal of the teacher or designer is to seek a conceptual model of the topic that matches up with the user mental model to facilitate learning.

There is evidence provided by researchers that conceptual models are useful in the learning of complex tasks. Mayer (1989) concluded that providing concrete conceptual models for learners improves conceptual retention, reduces verbatim recall and improves problem-solving transfer. Good conceptual models make intuitive sense to the learners and use vocabulary and concepts that are appropriate for the learners. The reason for intentionally illustrating the conceptual components to enhance learners' mental models of the content being structured. Conceptual models can be effectively presented before instruction or during instruction. Another reason for providing learners with the conceptual models of the problem solving domain being studied is because they explicitly represent the structural knowledge required to support problem solving (Jonassen et al. 1993).

Capturing Novices' mental Models

The first task of our study was to assess the mental models of the novices through familiarity with their backgrounds. As it is not possible to obtain an accurate mental model for all users, we would only consider where mental models are incomplete or erroneous, by researching the classes of problems that novices have when using the Internet technologies. We conducted surveys with an initial set of subjects by administering a questionnaire. This had 3 main sections of mainly multiple choice questions addressing the subject's background, computer experience and Internet experience. 63 complete questionnaires were returned by 47 high school students, 4 teachers, 2 university students, and 10 members of the general public. Of these 3 high school students were clearly identified as experts and these were omitted from further study. Of the remaining subjects 53 had up to 1 years' experience of the Internet and 3 years' experience of personal computers. The questionnaire provided an opportunity to discover novices' common problems and perceptions of the Internet. This allowed us to identify the most appropriate questions to ask during the follow-up interviews. The follow-up interview questions focused on gathering information about subjects' conceptual knowledge to help us identify current levels of understanding and deficiencies in the mental models of the subjects. This information was required to aid design of conceptual models of the topic that will connect with the subjects' mental models.

The follow-up interview questions concerned the problems that subjects encountered when using computers and the Internet. In particular, questions concerned problems of navigation (both on-line and off-line), such as getting lost through folders (off-line) and getting lost on the Internet. We also sought to discover how many subjects used keyboard shortcuts or the right mouse button to access menus. These are important indicators of lack of computing ability and mental model development. Only three subjects mentioned shortcuts. It would appear that novices did not realize that it is possible to use shortcuts when browsing the Internet. Other questions addressed the task of moving data (either text or image) from a web page to another document. Only two subjects mentioned copy and paste as a method of doing this, indicating general lack of conceptual knowledge about cutting and pasting. This tied in with information gained in the follow-up interviews that subjects did not perceive using the Internet to be similar to using the computer in other familiar situations. It would appear that mental models of computer usage were not being employed and developed when browsing the Internet.

Searching on the Internet caused a large number of problems for the subjects. They had little or no concept of searching as a process and the effect of syntax, semantics and Boolean logic on the results returned. Our follow-up interviews confirmed a gap in the subjects' conceptual knowledge of the search mechanism. Many did not see the link between the Internet search activity and other search methods used. In this respect it was interesting that no-one suggested the 'file finder' application on their personal computer was similar to Internet-based searching, which implied that the subjects were unable to link their mental models of off-line searching to on-line tasks.

The subjects had little or no concept of how a web page was down-loaded onto their computers. Mental models are clearly under-developed in this area, which was identified as an area for the development of a conceptual model. With a model of the web page downloading process, subjects would be able to understand issues that affect the speed of transmission of data or occurrences such as the HTTP 404 'File not found' error.

Difficulties were identified with the Internet address, the Uniform Resource Locator (URL). The subjects had little or no idea what the constituent parts of the URL mean, which can hamper problem solving. Specifically, they did not recognize the parallels between a house address made up of a number of elements that provide different levels of information about the location (street, city, country) of the house, and a URL having distinct elements that identify a particular computer, the domain that computer resides in and the service tha: is required of it. Furthermore, the subjects were not aware that, in effect, the Internet is one big (and very dynamic) file system and that the slash separators in an address signify directories on the remote computer. Consequently, they could not apply their mental models of file systems and file manipulations. This impacts upon their problem-solving abilities. For example, when novices come across broken links, or cannot find a file or page they expect to find, they often do not know how to go about solving the problem. By applying knowledge of file systems and directory structures to the structure of URLs, users can strip parts of the address in the hope of being presented with a directory structure to browse.

Development of Conceptual Models

The conceptual model of the topic is the teacher's representation of the knowledge to be transferred. In order for a teacher's conceptual model to be effective in facilitating learning, Norman (1983) proposed that the conceptual model should meet three basic criteria: learnability, functionality and usability. Learnability means that the conceptual model should be easy to learn. Functionality means that the model corresponds to important aspects of the topic. Usability implies that the model should be easy to use, given the limitations of the human information processing system.

In designing conceptual models, designers must take into account the kind of things an expert considers, such as what problems and errors are likely to be encountered in a given situation. This conceptual model thus gives context and meaning to the topic, which further allows facilitation of knowledge through connection with novices mental models. In order to develop conceptual models to help novices in their understanding of the Internet search, we have to interview experts. This is necessary because a conceptual model must provide an accurate and consistent representation of the subject to be learned.

Applied Cognitive Task Analysis (ACTA)

As the activities involved in searching the Internet are complex cognitive tasks, we chose the ACTA method to elicit the cognitive skills or mental demands needed to perform the task proficiency from the experts. The main reason for choosing ACTA is that it is a streamlined version of analyzing complex cognitive tasks. It is designed to be more useful for the design of actual systems and easier to perform than other cognitive task analysis methods. ACTA is a structured interview method for eliciting appropriate task knowledge from subject matter experts (Militello & Hutton 1998). As a methodology, ACTA is particularly suited to the generation of learning objectives and the revision of existing, or creation of new, training manuals. The three interview types that comprise ACTA are the task diagram, the knowledge audit and the simulation interview. The interviews aim to help subject-matter experts verbalize the cognitive strategies used in task performance.

Step 1. The Task Diagram: The task diagram is the preliminary interview and is intended to elicit a broad overview of the task or tasks. The first step of ACTA begins by asking the subject matter experts to break down a particular task of interest into four or five steps and to highlight which of the steps requires different cognitive skills. For our study two subject-matter experts, both university lecturers, were interviewed, the information collected was documented and a task diagram constructed.

Step 2. The Knowledge Audit: The knowledge audit step elicits the aspects of expertise required for particular tasks or subtasks. The interview is based upon 'knowledge categories' such as diagnosing, predicting, perceptual skills, improvising and recognition of anomalies (Militello & Hutton 1998). A series of questions or probes that address each of the knowledge categories are used to obtain information about whether the particular skill is present in a task. In addition, strategies for its use and specific examples of its use are uncovered. The example is probed for the cues and strategies used in determining and dealing with the situation and potential errors a novice might make in the same position. A tape recording of each knowledge audit interview was reviewed and the data organized into a knowledge audit table. The table includes examples of where a particular skill (knowledge category) was used, the cues and strategies used in dealing with the situation and why the situation might be difficult for novices.

Step 3. The Simulation Interview: In the simulation interview, information about the experts' cognitive processes within the context of a task is gathered. This is accomplished by the presentation of a challenging scenario to the expert. In our study scenario was "Full text search using a search engine" The biggest challenge with any type of on-line searching is choosing the right search terms or keywords. Because web search engine databases make no distinction between the various types of information available about a certain topic, doing a search about, say, a famous author, will probably get a hotchpotch of web sites, many of them personal home pages created by fans of the said author.

Step 4. Sorting Out Key (Cognitively Demanding) Tasks: The final stage of the ACTA process is the construction of a cognitive demands table to sort through and analyze the data collected in the previous three stages. This step allows the less relevant information to be filtered, thus, focusing the analysis only on specific goals.

The ACTA analysis in our study revealed the difficult cognitive elements in Internet tasks, the kinds of problems an expert expects when performing these tasks, strategies for solving problems and why the tasks might present problems to novices. These types of information are important components of the conceptual models to be developed. Presenting the information to novices in conceptual models is a fundamental aspect of constructivist learning (Brandt 1997). The data collected during the ACTA analysis are used to develop the conceptual models that would be implemented in the constructivist learning environments for novices to learn about Internet searching.

Representation of the Conceptual Models

We believe that analogies are powerful representations to help learners understand complex tasks such as searching the Internet. Analogies can give the novices a visualization that is very easy to relate to and they force the novice to compare and contrast to understand the analogies. The analogies chosen should be related to existing mental models held by learners. Often the analogy alone is not enough to accurately convey the conceptual model. Learners must be encouraged to look at the similarities and dissimilarities between the analogy and the topic. This can be achieved by supplementing the analogy where necessary with appropriate technical information about the topic and with practice examples that lead the learner to compare and contrast. Analogies can be tailored to help the learner acquire problem-solving skills.

In order to understand the (unfortunately common) problems associated with loading web pages, some of the underlying mechanism of the transfer of data must be incorporated into the conceptual model. In this case, major concepts include the client server model, the need to make a request of the server for a web page and the subsequent reply from the server (either an error message or the requested page). Possible problems when requesting a web page can include: the original request being lost, an extremely slow response from the server, a time-out of the original request, the reply from the server getting lost or timing out, etc. Therefore, the conceptual model must address the fact that problems can occur with firstly the request and then the reply.

An example of an analogy we developed to convey this was that of ordering a pizza over the telephone from a pizza restaurant. In this analogy, the person ordering is the client, the restaurant is the server and the pizza would represent the web page or file that was to be downloaded. Initially the person must make a request or order the pizza. To do this they need to know the telephone number of the restaurant. On ringing the number, one possible problem is that it will be engaged. This is analogous to a server not replying to the initial request for a web page and illustrates that the request for a web page has to reach the server to be satisfied, but may possibly 'fall at the first hurdle'. One reason for a request not reaching a server is that the server is extremely busy dealing with other requests. Again, the engaged line can convey this possibility. This analogy can be particularly useful in helping users interpret error messages that they receive whilst browsing. Rather than implicitly accept that an HTTP 404 error means that the page requested does not exist, or that a server is down or inaccessible, the user can interpret it as a busy line to be tried again. Redialling the number of the restaurant or re-clicking the hyperlink a few times often cures the problem.

The pizza restaurant analogy can also help to explain other possible problems in the delivery of a web page to the client computer. If the pizza restaurant is very busy with lots of orders (requests for web pages) to deal with, it is likely that the order take longer to be fulfilled and despatched. With the Internet, as with pizza, patience is the key. The speed of delivery is not only influenced by how busy the restaurant (server) is, but also by the amount of traffic on the roads between the restaurant and the client's house (computer). If the traffic is very busy on the roads (or the networks that constitute the Internet), it is likely that it will take longer for the delivery to arrive. Furthermore, there is always the chance that the delivery person will get lost, as can happen with the reply from the server.

According to Jonassen (1997), a good conceptual model contains a visual representation of all of the essential parts, states, or actions encountered in the problem and the relationships between them at a level of detail and familiarity that are appropriate for the learners.

Web-Based Courseware

A web courseware application based on the conceptual models derived for both Internet Explorer and Netscape was built by us for novices to use. This provided a learning environment in which novices could learn about searching on the Internet through interaction with the courseware. The exercises were also designed along constructivist principles to reinforce the conceptual models. Topics for novices included hyperlinks, URLs, HTML, the history mechanism, cut & paste, searching and web site structure and organisation (including home pages). In order to address the need for technical knowledge, the conceptual model presented of the task of following a hyperlink, for example, is described not only by an analogy, but also by concepts that underline the loading of a web page, such as client/server and request/reply protocols. Procedural knowledge is also supplied where this constitutes 'tricks of the trade' such as the use of the right mouse button as a shortcut to access context-sensible menus.

Evaluation

The courseware was given to a group of novices to evaluate. Twenty-six subjects took part. To evaluate the courseware module, they were each given the same searching exercise to undertake, working alone, using the courseware module. Following the learning exercise each was given a questionnaire to answer, following the exercise. The questionnaire used multiple choice questions, as a 5 point ranking, to elicit the novices opinions on ease of navigation through the module, how easy they found the module to follow, its balance, comprehensiveness and interest, together with Yes / No questions on whether using it had boosted their understanding, their knowledge and their confidence in Internet searching. Comments about their own skill levels and about aspects not addressed by other questions were also elicited.

Only 4% of subjects had difficulty in navigating through the module, with 96% of subjects giving the top two rankings for these questions. 73% judged the module easy to follow giving the top two rankings, while 92% gave the top three rankings.

The questions addressing the effects of the module on the learning outcomes for the subjects found that 65% considered that it had increased their understanding, 60% that it had increased their knowledge but only 54% that it had increased their confidence in searching on the Internet. The first two outcomes are lower than we had expected, but may be due to a greater initial level of capability than we had measured. The figure for increase in confidence is more disappointing and would be difficult to explain in terms of already high confidence of subjects in their ability. Our experiences with the group do not support this. It may be that we administered the evaluation questionnaire too soon after the learning experience, before the subjects had the chance to develop their new skills through practice.

Generally, we may claim that the majority of the novices found the learning environment useful in helping them to understand the basic principles of searching on the Internet. These novices also confirmed that the conceptual models were useful and helped them to have a better understanding of the search process involved and how to locate necessary information.

Conclusion

Successful Internet use requires problem-solving skills and technical concepts that are only acquired through experience. We have demonstrated in our case study that using appropriate conceptual models that are connected to users' mental models can help novices learn searching on the Internet. It is our belief that the idea of the use of carefully derived conceptual models stimulates learners to think about the similarities, or differences, which conceptual models describe. Using conceptual models that are connected to their mental models helps learners predict or solve problems.

Further evaluations are planned to provide more convincing evidence of the effectiveness of the use of the conceptual models used in the courseware. Our experiment illustrates that the development of a conceptual model is not a trivial matter and much further research is required. However, it has demonstrated that a constructivist approach to courseware development using conceptual models in learning can help novices to acquire an understanding of the Internet search mechanism.

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Examia: A Course Management Environment for the Web

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Abstract: Examia is a website that provides instructors with a free environment to create and manage courses, and students with a rich on-line experience. Examia features cooperative document creation and management among instructors with seamless integration of mathematical expressions and collections of bookmarks, as well as shareable, categorized questions databases and automated, self-correcting exams management. Its interface is dynamic, and presents different views to instructors and students. Examia also supports student sharing among instructors, so that students -at each institution- may be presented with a unified view of their academic standing.

1. Introduction

Examia is a website dedicated to teachers and students. It offers a wide array of free educational and administrative services under the assumption that cooperative document creation and sharing, and dynamic, automated interfaces can enhance the educational experience of students and the creative process of teaching. Examia is designed so to provide instructors with easy-to-use tools to produce highly structured, coherent course contents, resources and schedules. Students, on the other hand, benefit from Examia's dynamic and instantaneous flow of information, designed to reach those who need it when they need it. Examia avoids student disorientation and cognitive overhead when dealing with hyperspaces (Yeh 1996), while allowing students to participate in the "learn any time, any pace, any place" paradigm, and to have access to Web resources in a structured format.

Briefly stated, cooperation in Examia occurs when an instructor decides to share an electronic document with some peers -a questions' database, or some course materials. On the other hand, within Examia, every decision and item set by an instructor is propagated automatically to all items and web pages related to it.
Further, through a simple dynamic hypertext design, Examia provides instructors and students with personalized views of course-related or administrative pages. An instructor who owns a certain page, for instance, has a different view of it than a student: beside a bookmark, the former will find an "edit" link, while the latter will not; the former may view a private bookmark, while the latter will not; a student, on the other hand, will have an exam link on her page, which, as soon as its deadline expires, will disappear.

Examia is commercial in nature -it follows a business model similar to that of MyYahoo!- and it was born out of ideas set forth in previous work on automated exams on the Web (Vantaggiato 98a), and course management (Vantaggiato 98b). Examia is at alpha stage at the time of this writing, and we expect it to be on-line by winter 2000 for beta testing.
This paper will first examine the services provided by Examia (section 2), in section 3 some design concepts will be discussed. In section 4 a short overview of related work will be presented, and in section 5 we shall draw some conclusions and directions for future work.

2. Examia's services

Instructors own a personal portal through which they can set up a series of items useful for their courses -both on-line and regular. Students also own a personal main page that reflects whatever their teachers set up for them. Students' and instructors' portal pages are so both designed with the "push" delivery mode in mind, but it is instructors who decide what gets pushed to students, up to a certain extent.

Through the Examia Centre Page instructors may:

- Set up a hypermedia web-based course, with its main homepage (HP), calendar, bookmarks and references.
    - Within a course HP, instructors may also define an Ebook, an electronic textbook that can be co-authored by multiple peers; Ebooks contain hypermedia and one or more sections: each section has its set of personalized, annotated bookmarks,
- Register students in courses;
- Set up a categorized questions database for each course. Categories may have up to three sub-categories each and may be shared among peers;
- Set up on-line exams; the multiple-choice part of each exam is self-correcting with automated feedback, while the "subjective" part, if any, needs the instructor's direct evaluation,
- Check and edit students' grades;
- Post classes' final grades.

Also, they may:

- Set and maintain a personal calendar;
- Communicate with peers and students through a simple messaging interface (not depending on e-mail): instructors always have a message center available in their personal pages,
- Read news headlines.

(Fig. 1) shows a section of an instructor's Examia Centre.

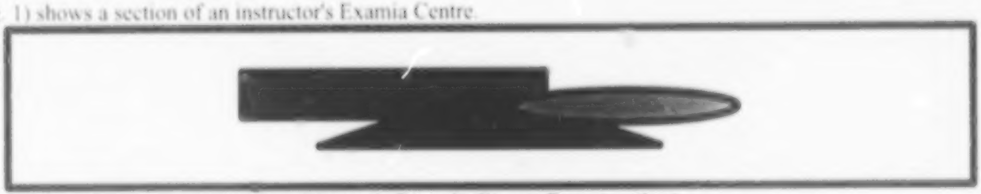


Figure 1: Examia Centre Page (section)

Through their Examia Student Page, students have a clear grasp of their whole academic situation, including:

- Past courses' grades;
- Present courses' partial scores (including comparative bar charts of their proficiency),
- Links to current exams,
- A message center.

Work in progress include students' calendars and chatrooms, as well as the capability of checking who their peers are at a given institution. Students' calendar are almost fully implemented, and they give an interesting account of Examia's synergy: in fact, a student's calendar is automatically computed as the union of all his classes' calendars, except that he may override some class event with one of his own (if he decides to miss a class, for instance, in order to attend an important meeting).

A simple description of some Examia functionalities follows, in which we discuss a few aspects of its dynamic hypertext design and information flow.

As soon as an instructor sets some item, the change is immediately reflected in her students' pages. When she defines an exam, a link to the exam's on-line page appears on all the registered students' pages, and stays there until the exam's deadline expires. As soon as the student takes his exam the link disappears, and is replaced by a note with the exam's name and the student's score. When, at course end, the instructor posts the class' final grades, they also get published seamlessly into every student's page (and stay there), while all partial scores for that course disappear.

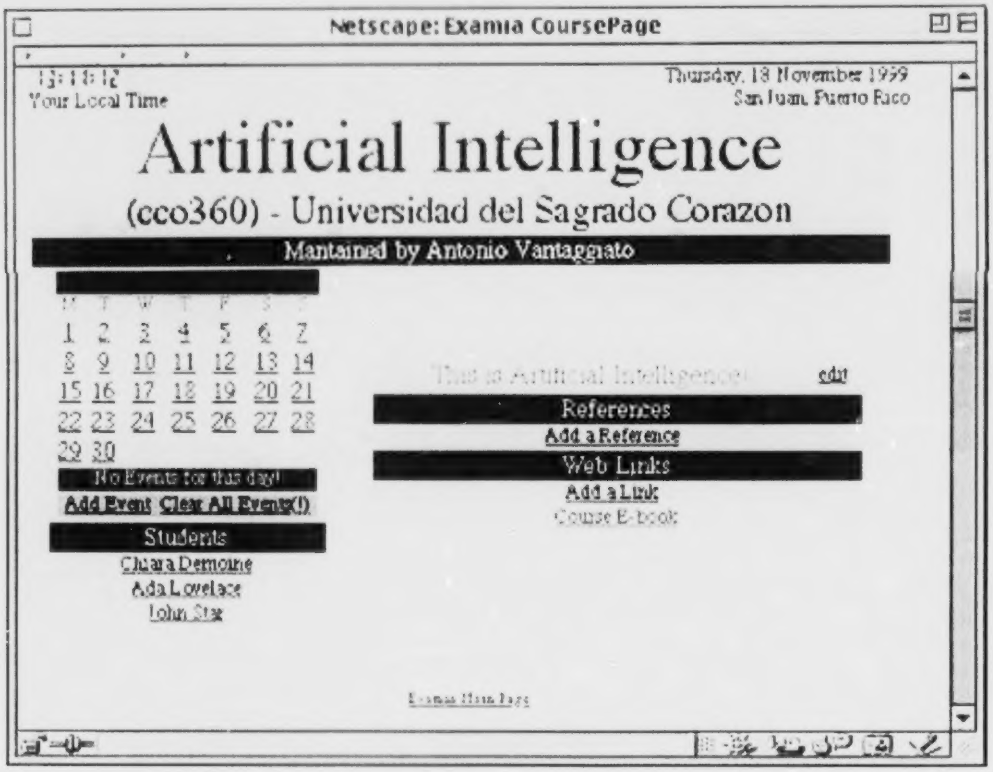
Another example of Examia's dynamic hypertext design may be seen when an instructor wishes to share a category of questions from his database with a peer: the latter is notified of this, decides which category she wants the shared category to be appended to, and from then on the shared category -with all its questions- is seamlessly and transparently integrated within her own.

2.1 Students are at the center

Students would not benefit from Examia if they had to access a different page for every instructor thay have a course with. Thus Examia is designed to let instructors share students among them, through a centralized student database that is "owned" by a specific institution. Intructors register their own institutions, then register students in every course they wish to set with Examia. Thus Examia unifies the view each student has of his courses, providing him with a valuable, integrated studying tool. Moreover, since Examia is Internet-based -not limited to an intranet-, students and instructors may benefit from the "anywhere, any pace, any time" paradigm, since Examia allows the very idea of virtual campus to be easily implemented. A virtual university may thus enroll students worldwide and assign each a unique ID. Instructors would then use these ID's to register students in their courses. As a side-effect, Examia would even easen the burden of mantaining a student database at an institution!

2.2 Creating a course

When creating a course, instructors may also define a homepage (HP) for it, which they will also maintain. A course HP (Fig. 2) contains the class' calendar, the students roster, references, and a link to course material that we call Examia Ebook.



13:18:12
Your Local Time

Thursday, 18 November 1999
San Juan, Puerto Rico

Artificial Intelligence

(cco360) - Universidad del Sagrado Corazon

Mantained by Antonio Vantaggiato

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

No Events for this day!

Add Event Clear All Events(!)

Students

Chiara Demonte
Ada Lovelace
John Star

This is Artificial Intelligence! edit

References

Add a Reference

Web Links

Add a Link
Course E-book

Examia Home Page

Figure 2: A course Home Page

Ebooks (Fig. 3) are an example of Examia's shared document management in that they may be co-authored by one owner and one or more peers. They contain hypermedia (limited for the time being to text, hypertext and images) that can be configured by the authors. Text may contain mathematical formulae and symbols, which can be easily entered by instructors with a special notation that follows Webeq's implementation of the W3C's standard MathML. In fact, for this purpose, Examia uses Webeq's applet, which is available either directly from their site, or by downloading a plug-in. In this respect, thanks to Webeq's applet and Examia's own process, Examia may well be the only web-based course environment that allows mathematical formulae to be easily integrated into any text.
A course HP, and its Ebook -in any section- may contain also collections of bookmarks, besides normal hyperlinks. Bookmarks are discussed in section 2.4.

BEST COPY AVAILABLE

Figure 3: A Course Ebook

2.3 Exams

Exams are designed by one instructor. She chooses a number of questions (both multiple-choice and "subjective") from the various self-defined categories belonging to a specific course. During the lifetime of an exam its questions cannot be edited nor deleted.

After setting the exam's deadline and some instructions, as well as other information, the exam is ready and on-line. Registered students will find the relative link well displayed on their pages and may take it (only once). When a student submits his exam, he is immediately notified of his evaluation and score (at least for the "objective" part of the exam that can be self-evaluated by Examia). The score is so recorded in the student's portfolio.

2.4 Bookmarks

Another feature of Examia is its bookmarks management. Users may add bookmarks:

- In their courses' homepages, and
- In each section of a course Ebook.

Bookmarks may be public or private: for instance, an instructor may set a few bookmarks in a section of one of his Ebooks, that he does not want his students to see. Like everything else on Ebooks, bookmarks can be shared among co-authors: each may add or edit them.

Bookmarks are viewed with their name -which is of course a hyperlink- and some annotation. Since they are entered in specific sections of Ebooks or in a course HP, they are already catalogued -if only in a very course-oriented fashion. In fact, they inherit a basic classification from an Ebook's section title.

Work is programmed for the immediate future, in order to give users the capability of adding bookmarks while browsing, and of automated cataloguing. In fact, we would like to provide a second, more general classification, to bookmarks, to be inferred automatically. This would allow for bookmark search from a user page, by using simple catalogue criteria. Also, we think that users' work would be enhanced if Examia provided them with a system to add bookmarks and collect information while browsing. In fact, one of the problems we are addressing concerns the fact that instructors need to devote too much time on the search and collection of available material to be integrated into their own. Inspiration on these subjects comes from (Stefani and Strapparava 98), with their SiteIF project of personalizing access to Web sites, and from (Keller et al. 97), with the WebTagger system for organizing and sharing URLs.

3. Design

Examia's server is implemented in Common Lisp within the CL-HTTP Hypermedia Server (Mallery 94) environment from John Mallery of MIT. It is multi-threaded, and makes use of Heiko Kirscke's object database system (Plob, Persistent Lisp Objects) that supports transactions and locks. CL-HTTP creates Web pages on the fly by means of Lisp programs and serves them through the HTTP protocol. Examia's implementation is fully transparent to end users (students and instructors): they need not worry about technical issues, not even HTML coding. Further, Examia is centralized, and all administration is done at the server level (Examia website): users only see its intuitive, easy-to-use interface in order to access its services.

The system can be continuously upgraded and mantained (even remotely) by CL programs that use Web interfaces. Measurements on performance are scheduled shortly. Both CL-HTTP and Plob documentation indicate that server and database performance is comparable to industrial-strength equivalent software. Plob DB's however, are limited in size, since as databases approach 1GB they tend to show decaying performance. Other Object Databases would be eventually needed: changes however will be relatively easy to implement, given Examia's modular, object-oriented design.

3.1 State Management

One design decision worthy of discussion is state management. While the common practice is to save the state of web transactions (at least partially) through cookies on the client, we decided not to use cookies, given their poor security and intrusiveness. Thus Examia manages state fully on the server, which is hardly a burden since cookies must be retrieved and processed by the server in any case. The method designed for managing state between transactions consists of two strategies:

- When it is feasible, store and retrieve data in/from the user's object in the database. Since transactions are authenticated, Examia always knows who is asking what. This strategy however is not always feasible or sufficient, for instance when, depending on user input, some page must be generated as an intermediate step. This is the case for the second strategy.
- Lexically scoping a variable that points to a new page created inside a server response. The variable is communicated as a parameter to a response function which, after completing its mission, "deletes" the new page. Parameter passing and lexical scoping ensure that the variable does not get confused with similar concurrent ones (perhaps coming from other users' requests) in the multi-threaded environment. Deleting the page after use ensures that the user does not go accidentally *Back* (using his browser's Back button) to that page, which is temporary in its essence.

3.2 Security

Another design issue is that Examia is not session-based. Users (instructors and students) are authenticated and each page they request is expired immediately. This gives a reasonable degree of security, while allows users to get the most up-to-date page. Also, it allows for easy user tracking.

Security is also enhanced by the fact that in Examia there is nothing to be hacked! There are no HTML pages stored on the server -except the terms-of-use page and a few others-: everything is generated on the fly by (compiled) Lisp programs. Further, users' passwords are contained in a compiled Lisp program file, which is protected by operating system security. Plob database can be hosted on a different machine, protected behind a firewall.

4. Related work

Much work has been devoted to hypermedia-based systems for the Web that support teaching and course administration, and a series of commercial programs exists today. They can be generally grouped in two broad categories: 1) local systems: they require on-site installation and administration, and are a mature technology; the foremost examples in this category are Lotus' Learning Space and WebCT (Goldberg 96); and 2) those systems that are fully Web-based, usually centralized, like Nicenet's ICA (Internet Classroom Assistant), or BlackBoard.

In the first category, WebCT is a very mature and complete environment for on-line courses. It may be downloaded free, but requires a licence to be deployed. WebCT provides users with web tools (search, etc.), course contents pages which may be organized in paths, reference-creation tools, bulletin boards and notes. Some HTML must be mastered in order to create course content. It requires installation on a local server, but no inconvenience in administering the software.

Learning Space, on the other hand, is quite a sophisticated system that requires local installation and non-trivial management, and is the most expensive.

The second group is where Examia belongs: Nicenet's ICA is a very serious effort at on-line course management, and is offered for free. It provides users with conferencing, document creation, link sharing, conferencing and class scheduling, among its most interesting services. It has a pleasant and simple interface. The last example system, BlackBoard, is commercially available in two flavors: a limited version for free and a more space-generous version to be acquired through a licence. It allows discussion and collaborative work groups, content creation tools, chatrooms, a whiteboard, messaging and statistics.

This is only a brief overview of related work, and it includes the (subjectively) most interesting examples of web-based courseware available today. Like Examia, they are pleasant and easy to use by non experts, with some limitations; also, they include some test preparation and administration tool; few however, show (or support to a limited extent) the features that we discussed in this paper, namely: structured document co-authoring and management, including bookmarks; categorized, shareable questions database; and mathematical expressions.

5. Work in progress and Conclusions

Examia collects much information on each user (with a strict privacy policy), especially instructors. For instance, from course names, Ebooks' titles and references, a lot may be inferred regarding an instructor's area of specialty and interests. By organizing and structuring such information in user models, Examia could help users with their searching and collecting material and bookmarks for their courses, and with automated bookmark cataloguing, as was discussed above in section 2.4. Future work includes these enhancements, that would scale Examia from a dynamic hypertext system to an adaptive hypermedia authoring tool (De Bra 98), (Brusilovsky 98).

In this paper we have presented a web-based environment to create, manage and enjoy on-line courses. We have shown some important features of Examia, such as shareable question categories, automated, self-correcting exams, co-authoring and management of electronic textbooks, bookmark management, and the integration of mathematical expressions into any text. Through dynamic hypertext each user has an appropriate view of his material, which may be edited only if the user owns it.

We have also shown how Examia allows a synergy to emerge at an institution when instructors, by transparently sharing students' portfolios, allow students to have a unified and synchronized view of all their academic work. Institutions may benefit of this synergy, in that possibly Examia can lessen the burden on their management of students' databases.

Finally, Examia is very easy to use for both students and instructors, in that no knowledge of HTML or other Web technical feature is necessary, and instructors and institutions have nothing to install or administer -except of course their own courses!-; last, Examia is free to use.

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URLs

1. Learning Space: www.lotus.com/products/LearningSpace.nsf
2. WebCT: www.webct.com
3. ICA: www.nicenet.org
4. Blackboard: www.blackboard.com
5. Webeq: www.webeq.com
6. MathML: www.w3.org/math
7. Plob: www.lisp.de/software/plob/Welcome.html
8. CL-HTTP: www.ai.mit.edu/projects/iiip/doc/cl-http/home-page.html
9. My Yahoo: my.yahoo.com

Web-Support for Activating Use of Theory in Group-Based Learning

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Abstract: This paper describes a series of experiments conducted within the context of a course on organisational theory which is taught at the Department of Management Sciences at the University of Twente. In 1997 a group-based learning approach was adopted but after the first year it was apparent that acquisition and application of theory by student groups was inadequate. In an attempt to remedy this problem a Web-based collaborative work environment was introduced in 1998 with the intention of encouraging students to read relevant theoretical material and also to reflect more on what they had read. In addition to hosting a 'theory repository', the collaborative work environment was designed to control the flow of work and to enforce rules for groups' access to the output of other groups, based on their own performance. Further changes were made and a third edition of the course was run and evaluated in 1999. A description of the educational setting and the Web-based "Theory repository" is presented. The evaluation results over the period 1997-1999 are presented and discussed. The extent to which the discipline of reading improved was evaluated, as were the effects on insight into theory. It turns out that the technical realisation works well. Uptake of the instructional tasks for reflection, however, only takes place if these tasks are perceived as being helpful.

Educational Setting

The course "People, Technology and Organisation-2" is given to 150-200 undergraduate students. This 200 hours course focuses on organisation theory and its relevance for designing business organisations. Since 1997 a problem-based learning approach was adopted (Barrows & Tamblyn 1980) with the intention to activate and motivate the students with authentic study-tasks. The students work in project groups each consisting of six or seven students. Over a period of 10 weeks the groups study theory and work on exercises that come with pre-defined case studies. The theoretical component consists of a textbook and 3 sets of 8 theory articles. The case studies refer to a number of organisational issues in car manufacturing. Parallel to the group work there are a number of lectures with small groups (40 students). In the lectures the student groups present their findings, after which discussion takes place moderated by an instructor. The final mark for the course is a combination of the individual mark for the textbook exam and the group mark for case reports. The 1997 course set-up was evaluated by (Smit & Riemsdijk 1998), exposing flaws in the theory part of the group work. In many groups, the transfer of what students have read individually to the group members was poor. This resulted in little use of relevant theories in the case-study reports by the groups. The question investigated in our experiments is thus: Can Web-support activate the use of theory in an efficient way ? The planned relation between the learning goals and the workforms is given in (Table 1).

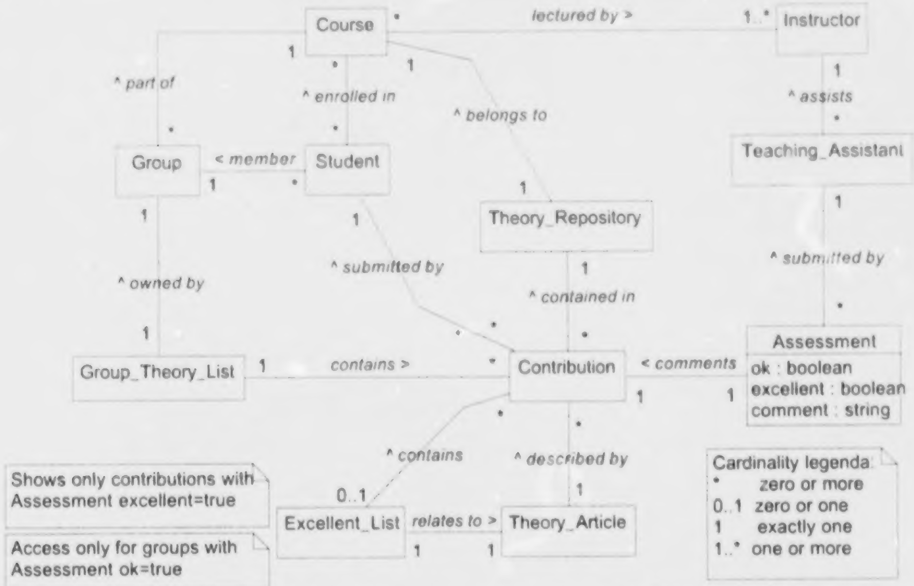
Learning goal	Theory & Web-site	Lectures & discussion	Group work & discussion
Knowledge acquisition	++		
Improving insight	+	++	+
Application in problem solving		+	++

Table 1: Relating course components and learning goals (++ primary goal, + secondary goal).

Design of a Web-Based Theory-Repository

To stimulate the reading of theory articles and reflection on theoretical issues, a Web-site was set up in 1998 with the aim of forming a "Theory-repository". The division of reading tasks was left to the groups. For each of the 24 articles on organisational theories every group had to submit a contribution which targeted the core of the article. This took the form of two questions about the article together with model-answers. The contributions of a group form a group resource. The set of contributions on a particular article together form a resource for all groups. This resource is only made accessible to another group after that group has submitted a serious contribution on that same article themselves. This basic quality assessment (group contribution is "not ok" or "ok") was performed by teaching assistants. The students also ranked the submissions of other groups, indicating per article which 5 contributions they judged to be of highest quality. This top-5 exercise was intended to further enhance reflection on theory. The 1998 evaluation results (Veen, Riemsdijk, Slabbekoorn & Kamp 1999) show that the discipline of reading theory articles had been enhanced. However the students felt that the formulation of questions and model answers did not help them very much in their group work. The students reported that, after finishing this assignment, they still had to work out summaries for their group. The top-5 assignment was felt to be "a waste of time" as reading sometimes more than 20 contributions on the same article took too much time and gave the students little added value. This top-5 assignment was partly ignored by the students, and finally skipped by the instructors on the last set of 8 theory articles.

Based on the experiences of 1998, a revised setup for the Web-site was introduced in 1999. Instead of questions and model answers, groups were now asked to contribute a summary per article. The summaries per group thus form a collection that the groups really need in their sharing of expertise. Ranking was now included in the grading by teaching assistants (group contribution is "not ok", "ok" or "excellent"). Instead of the obligatory top-5 assignment, the students were now offered the option to read a small number of excellent summaries by other groups, again only after a serious contribution on that same article by the groups [illegible]mselves. The goal of this re-designed cross-group exchange of expertise was to stimulate more efficient reflection on theory. (Figure 1) shows the relations between the main concepts in a UML class diagram (Larman 1998).


Course
lectured by >
Instructor
^ part of
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^ belongs to
^ assists
Group
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Student
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Theory_Repository
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excellent : boolean
comment : string
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Excellent_List
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Theory_Article
Cardinality legenda:
* zero or more
0..1 zero or one
1 exactly one
1..* one or more

Figure 1: UML class diagram of the 1999 version of the "Theory Repository". Reading directions of relations is indicated by symbols (^,<,>).

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Ergonomics design was improved in 1999 by analysing the sequences of mouse-clicks required for basic actions like "reading group contributions", "reading contributions of other groups", and "assessing contributions" (Veen, Riemsdijk, Jones & Collis 2000). When students log in to the course site a personalised user interface is given (Figure 2), offering only options that are accessible to the user.

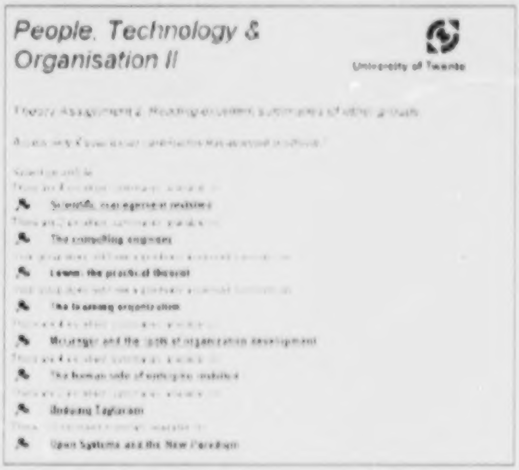

Figure 2: Example of a personalised screen offering conditional access to excellent work of other students.

Technical Realisation

Microsoft Internet Information Server was used as the Web-server. Group contributions were stored in an MS-Access database, accessible to the server through ODBC (Open DataBase Connector). Active Server Page (ASP) scripting was used to implement writing to and querying the database. All relevant ASP-code uses ODBC-calls, making the application database independent. Because the operating system (Windows NT) does not provide a hierarchical group mechanism, a dedicated user administration add-on using ASPUser was set up. This solution exposes the full Windows NT user administration and the file ACL's (Access Control Lists) to ASP and allows user management via a Web-browser. This permits the formation of groups at the course and project group level, as well as the implementation of roles and accompanying privileges.

Evaluation approach

This experiment can be considered as a time-series based case study in a natural setting. The 1997 course had no Web-support and that year's evaluation data can be used as a baseline. In 1998 telematics support was introduced. Finally in 1999 the telematics support evolved as described above. The main goal of the implementation and therefore the main evaluation questions involve the value of the Web-site in improving reading discipline, Question 1 (Table 2). The improvement of insight was thought to be reinforced by realising a number of instances for reflection through cross-group reading of other groups' work (Question 2). The planned for reflection was hopefully perceived as being helpful by the students (Question 3). To see if minimal conditions for proper use are met, the ease of use (Question 4) was checked. Also we looked for indicators of improved student results (Question 5). Evaluation data are gathered in different ways. The triangulation strategy (Stake 1995) is given in (Table 2), indicating for each of the questions the primary source of information, as well as additional sources for confirmation or contradiction.

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Question	Primary source	Additional source(s)
Q1 Does the Web-site help improve the discipline of reading theory?	Theory repository	Student interview
Q2 Are students reading other groups work?	Event log	Student questionnaire Student interview
Q3 Is reading other groups work perceived as helpful by students?	Student questionnaire	Student interview & student questionnaire
Q4 Was the Web-site easy to use?	Student questionnaire	Key-stroke analysis
Q5 Does the Web-site improve student results?	Instructor interview	Course grades & event log

Table 2: Evaluation questions and evaluation methods.

Results

We assume the number of submitted contributions to be an indicator for the discipline of reading (Q1). (Table 3) indicates that for most of the 24 articles work is submitted in 1998. The raise in 1999 (23.2 > 26.7) is mainly caused by groups that submitted a new summary in 1999 after having received a 'not ok' assessment for their first submission. The teaching assistants approved 67.3 % of the contributions in 1998, versus 68.4 % of the contributions in 1999. The percentage of "Excellent Lists" for which groups received access is clearly higher in 1999 (76.1%) compared to 1998 (65.0%). This is caused by the additional submissions in 1999. In the interview, students indicated that they read the excellent contributions, to get information about the content of the different articles, to see how other groups are doing, and to get an indication of what an excellent summary should look like. Students prefer to read just the excellent summaries instead of all the summaries, because this would take too much time. Also, students indicated that they would like to have access to a summary made by the teacher.

Theory repository statistics	1998	1999
Number of submitted contributions per group	23.2 s.d.=3.7	26.7 s.d.=3.7
Percentage of approved contributions	67.3 s.d.=11.6	68.4 s.d.=8.0
Approved contributions per group in % of 24 articles	65.0 s.d.=15.5	76.1 s.d.=12.2

Table 3: Group means and standard deviations (s.d.) for the submitted contributions through the Web-site.

The use of all collected contributions by other students was analysed (Q2). In 1998 the event mechanism showed a total of 309 reading events, an average of 11 events per group. The number of events decreased with time when the top-5 assignment was cancelled. In 1999 this number has risen to 1465 events, an average of 64 events per group. Whereas in 1998 per article only one event per group was logged at the most, in 1999 an average of 4 individual group members were logged using the option to read excellent summaries. The score on item 1 in (Table 4) confirms our analysis.

Items on student questionnaire (1=disagree, 5=agree)	1998 n=83	1999 n=110	Significance 1999 / 1998
1 I always read the contributions on other articles.	1.97 s.d.= 1.10	3.37 s.d.= 1.42	$p < 0.001$
2 If I wanted to submit data through the Web-site, it was clear how to do this.	4.15 s.d.= 1.00	4.45 s.d.=0.91	$p < 0.05$
3 On the Web-site, I had a good overview of what was finished, and what still to be done.	3.52 s.d.=1.21	3.66 s.d.=1.16	not significant
4 It was fun to work with the Web-site.	2.35 s.d.=1.12	3.03 s.d.=1.12	$p < 0.001$

Table 4: Comparing appreciation of the Web-site of 1998 and 1999 (means and standard deviations).

To have an indication about the helpfulness of the Web-site support (Q3), the students were asked to give their opinion about the different workforms in relation to the relevant learning goals, see (Figure 3). For this 5-point scale questions in a questionnaire were used. In comparison with 1998, the 1999 Web-site shows significant higher appreciation scores ($p<0.001$) for its contribution to knowledge acquisition and insight improvement, and a slightly higher score for its contribution to the application of knowledge ($p<0.05$). The small group lectures are clearly highly appreciated. Also the group discussions are perceived as important for learning purposes. In the interview with a panel of students from different groups, the students indicate that the fact that not everybody reads every article, creates an interdependency that has positive effects on discussion and collaboration. The production of summaries for each other was thought to be a highly relevant task, as these summaries are a good introduction for those group members not having read the article. Access to other group's work also allowed students to compare their work with that of others. The score for item 4 (Table 4) supports our conclusion that the opinion of the students with respect to the Web-site has shifted from negative to neutral.

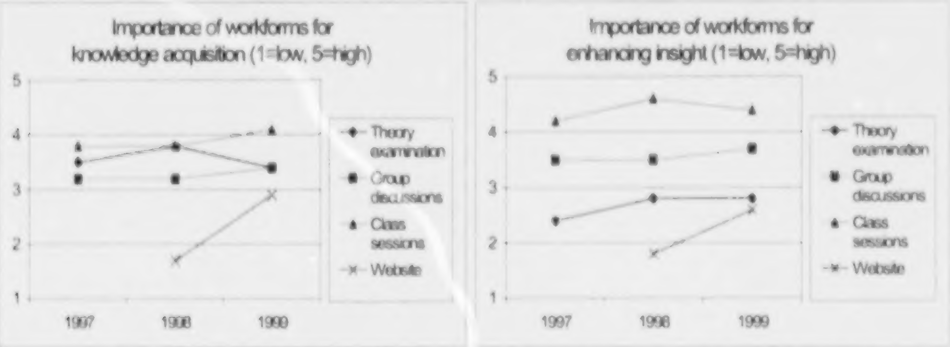

Figure 3: Student appreciation of the importance of workforms for *knowledge acquisition* and *enhancing insight*. Scores on a 5-point scale: 1=low, 5=high. 1997: n=110; 1998: n=83; 1999: n=110.

The Web-site was easy to use (Q4) according to the students, see item 2 (Table 4). Keystroke analysis (Veen, Riemsdijk, Jones, Collis 2000) shows that some tasks need less than halve the number of mouse-clicks in 1999 compared to 1998. The status information, item 3 (Table 4), will be further enhanced in the next edition of the course. It is difficult to quantify the effects on the final products of the groups (Q5). Instructors indicate that it is very hard to relate outcomes to specific learning events. The course design is an integration of different activities, that they think is now a strong combination. An analysis was carried out to check for correlation between two Web-site parameters and the theory examination and case-study grades, see (Table 5). The calculations were performed at the group level.

Pearson correlation values	Theory grade		Case-study grade	
	1998 (n=28)	1999 (n=23)	1998 (n=27)	1999 (n=23)
Cross-group reading (number of reading events)	- 0.23 not significant	0.01 not significant	0.11 not significant	- 0.04 not significant
Quality of contributions (percentage approved contributions)	- 0.41 $p < 0.05$	0.55 $p < 0.01$	- 0.09 not significant	0.07 not significant

Table 5: Correlation values for Web-site activity parameters and course theory and case-study grades.

Teams using the Web-site more frequently for reading the work of other groups did not score better in the grading of theory exam and case-study reports. Significant correlation is found between the quality of the contributions and the theory grade: -0.41 in 1998, versus + 0.55 in 1999. The negative correlation of 1998 indicates that some groups good in theory did not perform well in the Web-site activity, which was also theory related. A student-panel interview confirmed that their motivation for the Web-site task in 1998 was low. With the adjusted set-up for 1999, the percentage of approved contributions is now a positive predictor for the theory grade. Further analysis showed that there is no significant correlation between the theory grades and the case-study grades of the course. In the interview the instructors confirmed that transfer from reading theory to application of theory in problem-solving is not taking place as much as they would like.

Discussion

From our results it appears that both versions of the Web-site helped improve the discipline of reading theory articles. The revised 1999 set-up of the Web based "Theory Repository" was perceived as more helpful by students. This time substantial cross-group exchange of expertise took place. Although many factors have remained relatively stable over the years, a number of possible reasons for the differences in cross-group reading of contributions can be postulated:

1. In 1998 the contributions consisted of sets of questions and answers. The 1999 summaries may be more helpful when students want to learn about an article without reading it.
2. The pre-selection of the excellent articles in 1999 made this option more efficient for the students.
3. The difference of 'control' by students: choosing themselves to read work of others or not (1999), compared to being forced to read others work and then rank it (1998).
4. The improved user interface making the use of the Web-site more efficient.

The combination of changes in instructional design with an improved user interface makes it difficult to identify the dominant cause of the improvement. However, based on discussions with students, we believe that the first explanation, a relevant and helpful task, dominates the students' appreciation. Web-support can help organise these tasks in an efficient way. Although the Web-support thus activates the learning behavior of the students, students appreciate most highly those learning settings in which the students interact with their peer students and the instructors. However, we believe that these discussions are more fruitful when the students have been better introduced to the relevant theory. A correlation was found between the students' Web-related activities and the theory examination results, but not between Web-related activities and the final case-study results. Transfer from the theory parts of the course to the case-study problem-solving tasks is thus not as straightforward as anticipated.

Acknowledgements

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Designing a Web-based Distance Learning Environment based on an Intelligent Tutoring System

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Abstract: This paper describes a distributed approach towards designing an Intelligent Tutoring System for the WWW. This approach was implemented in the EDIT Learning Environment and is defined by several features as: a WWW dedicated architecture, a distributed way of working both in the design and exploitation phases, a heuristic method to gather the needed information from all people involved in the project rather than from a limited number of experts. Inter-human communication receives a great deal of attention, as it is an important speed up factor for the learning process.

1. Introduction

Classical Intelligent Tutoring Systems (ITS) are designed to support either the development of student's procedural knowledge by simulations or the development of conceptual knowledge by lectures and textbooks combined with answers to specific questions. Such systems usually do not support the acquisition of both procedural and conceptual knowledge.

This concept of ITS has to be changed when developing an ITS that use WWW as delivery vehicle for all the activities. The system has to be self-sufficient and complete (Brusilovsky et al. 1996), i.e. has to support the acquisition of both conceptual and procedural knowledge.

The advantage WWW brings is that HTML documents can be viewed using common web-browsers and low cost computer equipment. This is a major usability plus, as students, teachers and developers can access them from all over the world, without significant expertise or training. There are several other benefits that come from using the WWW platform:

- The use of standard and highly supported developing languages (HTML, PERL, JAVA).
- Cost-effectiveness and reusability in developing the ITS.
- Unified platform for ITS researchers to compare and exchange research results.
- Domain independence (i.e. allows the ITS to function across multiple domains: academic, technical, industrial, etc.).
- Universality (i.e. the web based ITS can be accessed worldwide, offering the largest possible pool of data).

One of the main drawbacks of the classical ITS approach is isolating the students. This is wrong as it can lead to deadlocks and a slow training process. It also makes the training less attractive for the social human being. This is why an extended communication system (email + virtual classrooms) between students and tutors has to be developed. This way deadlocks never appear and learning process is faster. Cheating is out of question as different students have different sets of exercises and simulations. So the communication system may act as an individual student exercise assistant.

2. Theoretical background

The traditional design of an Intelligent Tutoring System entails several modules: the Domain Model (DM), the Expert Model (EM), the Instructional Model (IM) and the Student Model (SM).

The *Domain Model* in this implementation contains a list of domain concepts and an order relation that establishes the sequence in which concepts should be mastered. The DM is not distributed, but it is stored on a server (and possibly mirrored) from which it is made available to all users.

The *Expert Model* consists of a list of tasks and/or questions and possible answers along with the domain concepts needed for solving them. In this case the EM is distributed as each exercise or simulation comes with its own part of the EM designed by the author. This is made possible by an easy and powerful scripting language and a well-defined interface between the EM and the SM. This allow the author to establish the way the SM will be updated as a result of the student's actions.

The *Instructional Model* tries to diagnose the student's level of knowledge and uses this information to determine what teaching materials should be presented to the student. The diagnosis is done using the data stored in the SM and the feedback from the EM. The IM is also server-based and not distributed.

The *Student Model* is the key to adaptability as it stores up-to-date information about the student's goals, knowledge etc, which allows the IM to make its decisions. This implementation is a differential one, which focuses on the differences between the student and the EM, and resides on the main server, due to the need to keep an accurate and accessible track of student data. There are several sub-models that are being used for organizing this data:

- The *Domain Knowledge Model* (DKM) is a fuzzy subset of DM representing domain concepts mastered by the student.
- The *Knowledge Delivery Model* (KDM) is a fuzzy relation between domain concepts and teaching materials. This relations override those set in the IM and may be modified only by the direct tutor of the student.
- The *Knowledge Genesis Model* (KGM) is a fuzzy relation between domain concepts, which shows the necessity of other concepts before another. Like KDM this overrides the implicit settings in DM.

3. Pilot implementation

This ITS approach was implemented in the EDIT Learning Environment (ELE) developed by EDIL R&D Centre, University "Politehnica" of Bucharest within the project "Open and Distance Learning Network in Information Technology and Microelectronics" (Drondoe et al. 1998, Voinea et al. 2000). The main characteristics of ELE are:

WWW dedicated architecture

The operation of ELE is based on the use of the WWW as the delivery vehicle for all the activities. The access is via a dedicated WWW-server (edit.pub.ro) using common web-browsers. The network structure integrates also a number of database servers distributed in the main centers of the EDIT Distance Learning Network.

Distributed way of working

Taking advantage of the opportunities provided by the WWW and in the spirit of interoperability principles a distributed way of working is promoted. Universally available libraries of teaching resources are used in order to provide instructional designers with the possibility to add, modify and delete materials. As a heuristic method to build the models specific to the ITS is used, every material that is published in the framework of the ITS has to undergo the evaluation of a certain number of Subject Matter Experts (SME) (Nielsen 1994). This will give the fuzzy relation between domain concepts and the teaching material enabling the inference engine to dynamically construct the recommendations for a specific student model.

Reusability

The WWW based architecture offers a high degree of reusability (architecture reusability). The general graphic interface is both domain and platform independent. The interface is also completely customizable by instructional designers. A new courseware is very easily translated in a form that ITS understands by specialized programs. They ask all necessary questions and perform all the heuristic evaluations to obtain the collection of necessary fuzzy models (DM, EM, and SM). Special tools have been developed to build new models using the concepts of the already existing domain models. New teaching materials regarding existing domains are automatically added to the libraries of teaching materials, the system taking care of the KDM update.

Heuristic approach brings ITS to college level expertise

For a long while ITS were the exclusive domains of high profile experts. This system tries to evade this confinement by replacing the expensive required expertise with the teaching community experience. Besides being cost effective, this method also provides much more realistic models that exhibit adaptive behavior when subjected to the real world. In order to create a teaching material the only prerequisite software is a word processor, an image editor and the basic Internet browser. There is no need for the SME team to understand the intimate internal knowledge representation scheme because the questionnaires are carefully designed (user transparent knowledge representation scheme) and this results in a major reduction of the development time.

Integrated communication system

This ITS has an extended communication system (email+virtual classrooms) between students and tutors taking part to the same training program. This way deadlocks never appear and learning process is faster. The communication system may act as individual student exercise assistant. It has been proved that an impersonal cyberspace does not help the intellectual development of the student. The human nature craves for social interaction and the paucity of communication leads to a stress that prevents the complete and thorough accumulation of knowledge and procedures.

Cost effectiveness

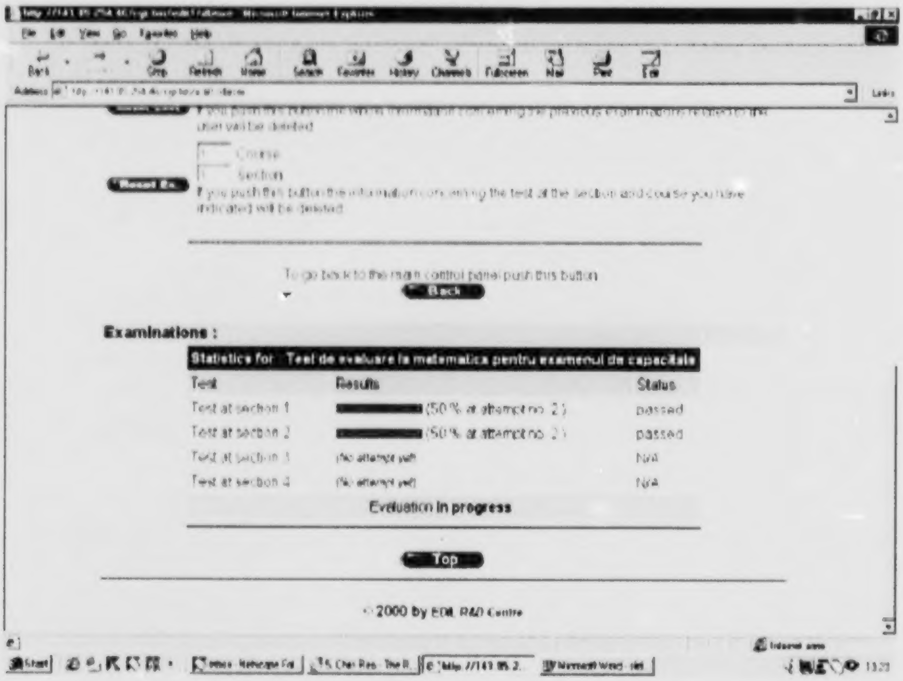
This ITS system's usability is reflected also in the low hardware and software resources it requires. The system has a client/server architecture. Both SME and students can work on machines that are readily available and cheap. These machines have all the needed software installed at the moment they are bought. The SME don't need special software to create and publish new learning materials. They may use their favorite text and image processors, so there is no need for additional training for SME. Also SME do not need to prepare materials for different computing systems because of the platform independence of this ITS. The only powerful machine needed is the server. The maintenance software for the server is freeware and the OS is either freeware or has quite an insignificant price.

4. Interface tools

The integrated web-based email system and the virtual classroms is servicing only the tutors and students involved in an ITS related training activity. The e-mail service is used to solve some of the communication needs regarding both the administrative problems and the exchange of information among students and tutors. The virtual classrooms allow students and tutors to meet at their convenient time and discuss aspects of the course that need more attention. Students can ask questions and they can meet even when the tutor is not available, but they can enter only in training program assigned classrooms. There exists the possibility to moderate the discussions and ban those who use the service inappropriately.

The online checking of tests and simulations is performed by server side programs that simultaneously update the DKM and allow IM to choose the best training material. Using this programs gives a very fine granularity (Woods et al. 1996).

The secure access to SM database allows tutors to supervise their students (Fig. 1). This way a particular student model may be tailored to fit exceptional needs that the implemented Fuzzy Logic Control System does not meet yet. Future development may bring a Learning Fuzzy Logic Control System, powered by an artificial intelligence engine, which infers future correction rules from tutor's tailoring actions.



Course
Section

If you push this button the information concerning the test at the section and course you have indicated will be deleted

To go back to the main control panel push this button

Examinations :

Statistics for Test de evaluare la matematica pentru examenul de capacitate		
Test	Results	Status
Test at section 1	(50 % at attempt no. 2)	passed
Test at section 2	(50 % at attempt no. 2)	passed
Test at section 3	(No attempt yet)	N/A
Test at section 4	(No attempt yet)	N/A
Evaluation in progress		

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Figure 1: Screen snap shot of student tracking database

The publishing tools are very simple but on the other hand they can be very powerful and productive. As a matter of fact they are usual editing tools (text + image) + email programs + a set of rules the tutors have to follow. This ITS practically introduces only a set of rules. This way the work of experts is deeply structured. It does not take much intellectual efforts, therefore it does not cause subjective errors and gives good results in practical applications. A new course is to be submitted as a package and has to be realized in a fixed structure concerning file names. On the other hand it offers a large degree of freedom from the point of view of the pedagogical approach. Each course has to contain a file index.txt in which the names of the chapters and the corresponding sections are presented in form of a list. For each chapter a number of files must be provided.

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These files are:

- Explanatory files (with the name page_m_n.html where m is the chapter number and n the section number);
- Exercise pages (with the name ex_m_n_nr.html where m and n are the same as above and nr is the exercise number);
- Simulation pages (a pair of JAVA client/server applications with the name simc_m_n_nr.class & sims_m_n_nr. class). The applications for simulation pages are subject to a set of supplementary rules and are addressed to those who are familiar with the JAVA language. The images and JAVA applets used in the course must be included in the packet but they are not subject to a name pattern.
- Pre-test and post-test pages (with the name pretest_m.html and posttest_m. html where m is the chapter number)

In short, for a new course to be submitted it should have the following format:

Index.txt	Contents in list form
Pretest_m.html	Pre test page
Posttest_m.html	Post test page
Page_m_n.html	Explanatory pages
Ex_m_n_nr.html	Exercise pages
Simc_m_n_nr.class	Simulation pages
Sims_m_n_nr.class	
Images+applets	Images and applets used when writing the course

For submitting the new course all the files of the package are sent as email attachments to a certain address.

5. Modus operandi

When a new tutor applies for a position in a certain domain he has to obtain first the endorsement of the ITS site coordinator. For this, a tutor can access a position request form on the site home page. They have to fill in the required information and send it to the ITS site coordinator. If the request is approved, the tutor receives a login name and a password to get into the system. He has the right to make accounts for new students and supervise their performance.

When a new student applies for a training program it has to obtain first the endorsement of a tutor who is registered with the program specific domain. For this the student has to fill in a sign up request form he can find on the site home page.

When introducing a new domain, a SME must obtain first the endorsement of the ITS site coordinator by sending a domain request form. He has to specify the relationships between the new domain and the existing ones. If the request is approved, the domain will be automatically registered with the site and it will wait for new topics and courses.

When introducing a new topic in a domain, a SME must obtain first the endorsement of the domain tutors by sending a topic request form. He has to specify in the form the relationships between the new topic and the existing ones. If the SME obtains the endorsement of the majority tutors the new topic is automatically registered with the addressed domain.

When introducing a new course in a domain, a SME must obtain first the endorsement of the domain tutors by sending a course request form. If the SME obtains the endorsement of the majority tutors, he will receive an automatically generated password. The SME will use it in the subject line when sending the course as an email attachment to a given address. Server side programs will then generate the course format. The domain tutors will be the only ones to have access to it. They will approve or reject then each individual section of the course according to what the section claims it covers.

The system granularity with respect to the interaction control is extremely fine as it uses the accepted human-computer interaction principle of providing immediate feedback following every response from the user.

When a student joins an ITS system he is subjected to a pre-test that tries to asses the domain concepts and areas that need working on. After this the computer generates an optimum path for the education experience, that the student is about to undergo. Each section on the path consists of a loop:

```
    Section{
            Pre- test ;
            Learning;
            Post-test;
             }
            until  (Post-test > threshold);
```

where all the elements are dynamically generated, according to the student's profile.

The course is considered completed when the final post-test mark is greater than a given threshold. When a student uses the Help/Assistance/Modeling options for exercise solving, the SM is updated such that the better the student model fits the student the less assistance is needed during exercise solving.

6. Conclusions

A framework for developing generic ITS has been presented. No restrictive assumptions were made, so ITS in any domain can be created.

The heuristic method used to gather the needed information from all people involved in the project rather than from a limited number of experts significantly shortens the implementation time. The main benefit of this approach is that it brings the designing of ITS to a less scholarly level, making it available to educators and students without requiring additional expertise and thus opening up a greater potential developer space. This would result in vaster set of teaching resources available for the ITS DM and EM.

One breakthrough of this system is that it implements a distributed way of working. Tasks are distributed among the project team and volunteer developers. They are able to work without being in the same geographical area, and their work is automatically integrated within the system.

At the basis of this implementation lies the WWW dedicated architecture. This has allowed us to reach a high level of reusability (i.e. reusability of architectures) and also cost-effectiveness. This architecture has permitted us to have an intense inter-human communication that significantly speeds up the learning process.

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An automated Evaluation Service for Educational Courseware

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Abstract: The World Wide Web (WWW) has been heralded as a significant opportunity to deliver successful tele-educational courseware and learning experiences. Because of its ease of use, the WWW has caught the imagination of many groups of people including educators. However, the instructors who develop educational experiences are rarely very skilled in interface design. This paper proposes an automated, third party WWW based evaluation service which focuses on usability issues of WWW based courseware and which can be used by any WWW course instructor/student. This paper researches the design, development and trialling of a WWW based evaluation service for WWW courseware. The paper then describes the facilities implemented by such a web based evaluation service and presents the results of employing this evaluation service twice on a subsection of an already proven WWW based courseware system and then once on an entire courseware offering. The paper concludes with an assessment of the benefits of using such an evaluation service to improve WWW based courseware.

1 Introduction

The last three years has seen a rapid increase in the use of web based educational tools, courseware and environments (Wade et al. 98). The central tenant of the WWW being that any individual or group of individuals (e.g. educators) can become a publisher of (educational) material. However, it is also well accepted that educational technology, over the last thirty years, has failed to achieve the revolutions that were initially forecast (Bates 95). There have been many technical reasons proposed for the failures of various educational systems, the two most widely reported being (i) the lack of pedagogical support within the educational systems (Maurer 97) (ii) the difficulties experienced by learners in using such systems (Turoff 95). This paper addresses this second most common cause of failure. Usability as defined by the International Standards Organisation (ISO) is the effectiveness, efficiency and satisfaction with which specified users can achieve specified goals in particular environments. Satisfaction is the comfort and acceptability of using the system (Macauley 95). The paper focuses on evaluating the levels of user satisfaction with presentation issues of educational WWW based courseware using a web based evaluation service.

2 Usability for Educational Systems

There has been a significant level of research into user interface design relevant to WWW based courseware. This section briefly summarises the important requirements related to user satisfaction for learning interfaces.

2.1 The Learning Environment

A learning environment must provide the learner with four key requirements (Duchastel 97) namely, information, interactivity, structure, and communication. The learning environment must also implement key interface design concepts (Jones et al. 95) which can be loosely categorised by research facilities, presentation details, integration across various media, appropriate use of tools, and help facilities.

2.2 Layout requirements of a Learning Interface

When planning the layout of the interface, many factors will require consideration including user engagement; the HCI principles categorised as Naturalness, User Support, Non Redundancy, Consistency and Flexibility (Macauley 95); interface structure; and the issues involved in the layout of instructional material such as document length, use of icons, and scrolling.

2.3 Presentation of Instructional material components

The components that are required to produce instructional material can be a combination of text, graphics, video images, etc. so many factors require considering. Another issue of concern here is the inclusion of colour.

Textual Material: When deciding on how to present text, there are guidelines that need to be adhered to (Rambally et al. 87). These include: placing key information such as urgent messages and instructions in a prominent and consistent location; standardising the terminology used; establishing prompt-string conventions (captions) in order to provide a systematic, predictable visual correlation between prompts and their corresponding data input fields; and positioning captions in a natural and consistent physical relationship to the corresponding data fields. It has also been suggested that screens are easier to read if the text is structured in natural eye sequences, such as from top to bottom (Hazen 85). When writing textual educational material, guidelines on how to lay it out should be adhered to also (Bailey et al. 91). These include paragraph formatting, font size, use of hyphens, and when to use upper case.

Non textual material: Interactive graphing, windowing, and animation differentiate the computer as a medium from most other media (Hazen 85). Tables can be used to graphically represent complex relationships (Schlegal 96). Graphics should be used when they contribute to the understanding of the text (McFarland 95). However, considerations of the size of the graphic should be made, as it should be able to fit into the graphical browser's window in order to provide the learner with the whole picture, and note also that a large graphic can take a long time to download. The minimum goal for response times should be to get pages to users in no more than ten seconds, since that is the limit of people's ability to keep their attention focused while waiting (Nielsen 97).

Colour: Colour has some uses when presenting material (Rambally et al. 87). These include: linking logically related data; differentiating between required and optional data; highlighting errors; separating various screen areas such as prompts and commands; emphasising key points; and communicating the overall structure. When applying colour, the following guidelines have been recommended (Macauley 95): use colour coding consistent with user expectations; similar colours should denote similar meaning; avoid use of extreme colour pairs to avoid frequent refocusing and visual fatigue; adults may need higher brightness levels to distinguish colours; colour blind users must be considered, as they may not be able to distinguish some colour combinations; use background colours in large blocks; group related elements by using a common background colour; use bright colour for emphasis and weaker colours for background areas; and brightness and saturation draw attention. In relation to WBI, there have been recommendations made (Jones et al. 97). These include: selectable areas should be clearly identified by a royal blue colour; interactivity is apparent by changes in the cursor as the cursor is moved to a hot spot; when a selection is made, the HTML standard is to immediately change to a dark red selection; and to indicate progress made, accessed links become a light red colour.

3 Evaluation Criteria

The objective of the evaluation service is not to evaluate the semantics of instructional material content but to identify any problems with the current interface that hinders or reduces the learner satisfaction and hence hinders the learning that occurs. The evaluation service needs to ascertain whether the present learning environment's user interface is conducive to learning, i.e. measure it's user satisfaction level in terms of the learner's experience. The approach of setting product usability goals and objectives (Mandel 97) was adopted to enable the setting of user satisfaction goals/targets. From these goals/targets, evaluation criteria were derived to measure the desired performance. The concentration of the evaluation was on subjective rather than performance measures because these determine the users' attitude with regard to how easy the interface is to learn, use and remember. The goals are shown at HREF 1, and resulting evaluation criteria are shown at HREF 2.

Assessing whether these criteria are adhered to requires gathering responses from individuals who have experience using the courseware being evaluated. Therefore it was decided that:

1. Courseware students participate in the evaluation.
2. A questionnaire should be used to gain feedback from the evaluation participants.

Each evaluation criterion was examined and rewritten as question statements followed by an interval response scale of strongly disagree, disagree, agree, and strongly agree. All the evaluation items were not explicitly included in the questionnaire as some items were combined with other items or were deemed to have been redundant. A list of thirty questions was produced. Rather than having a long list of questions it was decided to structure the questionnaire into five sections, one for each of the HCI principles as defined previously in section 2.2. Each question statement was examined and then placed into the appropriate questionnaire section. The full set of questions is shown at HREF 3.

3.1 Comparison with other Questionnaires

There are evaluation forms available on-line for measuring the usability of courseware on the Web, but they tend to cover all aspects of usability. Therefore, the level of user satisfaction with regards to presentation issues is only partially measured, as it is only one aspect of the questionnaire. Table 1 contains a comparison between four on-line questionnaires and the one presented in this paper. The questions compared are those, which are applicable to measuring the level of user satisfaction with regards to presentation issues of WWW based courseware. The questionnaires surveyed are included in HREF 4, HREF 5, HREF 6 and HREF 7.

	Toolbox	Comp 200	QUIS (OLT)	Henke	New Questionnaire
Appropriate Language Used					X
Style Used	X				X
Cluttered Screen	X	X		X	X
Natural eye movement	X	X			X
Use of extra features	X	X		X	X
Text vs Background Colour	X				X
Link Colour				X	X
Visited Link Colours				X	X
Meaning of Icons				X	X
Intuitive Navigation	X	X	X	X	X
Amount of Scrolling					X
Adequate Error Message					X
Adequate instructions	X		X		X
Availability of Instructions					X
Useful Examples	X				X
Adequate amount of Examples	X				X
Bookmarking facilities					X
Interface Perception				X	X
Feedback is prompt and useful	X	X	X	X	X
Consistent Terminology					X
Consistent Style					X
Consistent Error Message					X
Consistent Colour					X
Consistent Navigation				X	X
Consistent Headings		X			X
Amount of material per screen	X			X	X
Repetition of material					X
Repetition of navigational aids	X				X
Availability of Quit					X
Access to any module	X				X
Inclusion of Exercises	X				
Print Out facility		X			
Collaboration Facilities		X			
Overall Reaction			X		
Frame Use				X	
Search /Index facility				X	
Section Complete				X	
Provision of Cues				X	

Table 1: Comparison of on-line questionnaires for evaluating the levels of user satisfaction with the presentation of web based courseware

4 Developing an 'Evaluation Service' not just another on-line questionnaire

In order to validate the proposed questionnaire, an entire WWW based 'evaluation service' was developed. The main objective of the service was to allow any WWW course designer/instructor to register their course with the evaluation service and embed hyper-links from their course to the evaluation service. The service allowed instructors to password protect access to their own course and customise the questionnaire for their own course. By embedding a link to the evaluation service, the instructors were able to provide seamless access from their courses to the evaluation service. After the students completed the evaluation questionnaires, the instructors were able to retrieve an automatically generated detailed statistical breakdown of the evaluation results as well as a qualitative analysis and suggestions as to where the courseware could be improved. More specifically the evaluation service facilitated the following:

1. It allows *any* Course director to set up a course for evaluation. A course can be set up for evaluation by providing the evaluation service with her course's details. A password is chosen at this point for the course
2. Because a course director may wish not to include all questions, the evaluation service allows the course director to view all the questions available and deselect any questions that are deemed undesirable.
3. The on-line questionnaire is made available to the participant for completion. The participant must respond to all questions presented for the courseware being evaluated and may optionally provide comments and specify any relevant module/page titles for any of the questions.
4. It allows the course director to request the automatic summary and analysis of the responses submitted by participants for their course. The analysis produces Web pages of results for each section of the questionnaire. The analysis also produces Excel files of results available for downloading. The resultant analysis and summary not only allows the identification of specific weaknesses in the courseware but also the location of pages where this was perceived to occur.
5. It allows the course director reset the courseware when the analysis is complete; this facility deletes all generated analysis files and completed questionnaires making the course available to be evaluated by another group of individuals if desired.

5 Validating the Evaluation Service – Case Study

In order to validate the evaluation service, several iterations of using the evaluation service were performed. An existing, heavily used, WWW based self learning courseware on 'Relational Databases', was chosen as a validation study. The course, offered in Trinity College Dublin had previously been designed and implemented. Initially, a subsection of the courseware was chosen for evaluation. The modules chosen were the modules pertaining to the Select statement, which is one of SQL's data manipulation statements.

5.1 Iteration One Conclusions

The participants for iteration one and two of the case study were fourth year students on the BSc in Commercial Software Development, in Waterford Institute of Technology. Fourteen students participated in iteration one.

After reviewing the questionnaire results, some problems were highlighted, which reduced the level of user satisfaction with the courseware. The quantitative values that resulted from the responses made indicated that there was dissatisfaction with: the colours chosen for the links; the amount of scrolling required; and the repetition of menu items. The textual comments submitted included: there was a misuse of italics and inconsistent use of colours used for highlighting; on-line exercises and more examples needed to be included; it was not obvious how to proceed from a module to the roadmap menu; and feedback provided when a page is bookmarked was inadequate.

5.2 Iteration Two Conclusions

Twenty six students participated in iteration two. After reviewing the questionnaire results, it was concluded that there was a perceived improvement in the level of user satisfaction with the SQL courseware. There was an increase in satisfaction regarding: the use of colour; the reduced amount of scrolling; the elimination of menu items in the module headings and at the end of modules; the amount of examples used; and the error messages provided. However, one area that caused the participants difficulty was the facility to include Module exercises.

5.3 Iteration Three Conclusions

The changes applied to the subsection that proved successful were applied to the entire courseware. Other changes were applied also to enhance the interactivity of the courseware. The students who undertook the SQL courseware are from two-degree programmes in Trinity College, Dublin – BA MOD (i.e. pure computer science degree) and CSLL (i.e. computer science and linguistics degree). From the results and the textual comments volunteered by the participants, the following points can be concluded: the on-line exercises proved successful, but a change needed to be applied to the message displayed as a result of an error; the printable version of the notes also proved to be successful, but the images (tables etc.) that are displayed on screen needed to be available in the printable version also; 23% of participants felt that the icons were not intuitive, which is a significant level of dissatisfaction; the level of detail given for the module Oracle on Vax1 was not sufficient; more examples need to be included which introduces each new concept and statement; some of the windows that are used cover the Control Panel thus blocking out the facilities they provide; and the index and site map facility are not being utilised. The facility to cite a module/page that illustrated the response made proved useful in the analysis of the results, as participants used the text box provided to add comments also.

5.4 Conclusions on Evaluation Service results

For each question, the evaluation service provides numeric results in the form of percentage values that are generated from questionnaire responses. These percentage values identify strengths and weaknesses in the courseware interface. To provide some analysis for each question, the evaluation service may display a comment after the table of quantitative results have been output. If the number of responses that agree or strongly agree is greater than 60% then a comment from the satisfactory file is displayed, however if the number of responses that disagree or strongly disagree is greater than 60% then a comment from the unsatisfactory file is displayed. The comment for an unsatisfactory result indicates that there is a problem and that the associated feature needs attention.

At the end of each of the questionnaire sections, there is an overall percentage value output for each response value. The evaluation service may display a message indicating if the question responses for the section were very satisfactory (agree and strongly agree >70%), satisfactory (agree and strongly agree >50%), unsatisfactory (disagree and strongly disagree >50%), or very unsatisfactory (disagree and strongly disagree >70%).

The evaluation service does not perform a very high degree of statistical analysis, however an excel file for each section of the questionnaire is generated and is available for downloading.

The output generated from the response files displays the comments submitted by the participants also. These comments are output in two forms:

1. If a participant cites a module name or inputs a comment after a question, it is recorded with the question response. Therefore, when the evaluation service generates and outputs the results from the response files for each question, the module or comment submitted is output also. This can pinpoint where satisfaction/dissatisfaction with a feature resides.
2. The comment area at the end of each section of the questionnaire may be utilised by participants to submit general comments about the courseware. These comments are recorded and output by the evaluation service at the end of each result section. These comments can highlight problem areas also.

From a course instructor/designer viewpoint, the results output by the evaluation service are easy to read as each question is output followed by a table of responses, response percentage values, and the modules cited/comments given for each response value. As stated previously, the evaluation service may display a comment after the table of quantitative results for each question have been output. If there is dissatisfaction with a question, the comment output indicates that there is a problem and that the associated feature needs attention.

6 Conclusions

The use of such an evaluation service is an important component in the continuous improvement of successful WWW based courseware, and is an important tool in the rapid prototyping approach to successful courseware development. The criteria and questionnaire provide an explicit, easy to use method of evaluating users' satisfaction levels with presentation issues of educational systems. Although conceptually simple, the well-researched nature of the questionnaire and labour saving aspects of the evaluation service has led to a very successful tool to empower non-technical educators to improve their on-line courseware. In particular the labour saving features of the WWW based service as follows:

1. The evaluation service collected responses in a standardised format, thus aiding the quick production of quantitative results. The service not only performed the statistical analysis, but also provided an Excel file for further analysis/recording by the instructor.
2. It greatly reduced the overhead in processing the evaluation.
3. It provided semi automatic assessment of the study results. E.g. if 70% or more Agree or Strongly Agree with all statements for a particular HCI principle then the adherence to that principle is very satisfactory.
4. It promotes and encourages learner feedback and evaluation as it greatly reduced their effort in completing the questionnaire.

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HREF 2: http://www.wit.ie /research/objectives.htm

HREF 3: http://www.wit.ie /research/questionnaire.htm

HREF 4: Toolbox – An online evaluation form for Web-based course supplements http://web.syr.edu/~maeltigi/Toolbox98/sumeval2.htm

HREF 5 Comp 200 Evaluation Questionnaire http://ccism.pc.athabascau.ca/html/courses/comp200/cover/eval.htm

HREF 6: Evaluating Web-Based Instruction http://www.scis.nova.edu/~henkeh/hciproj.pdf

HREF 7: Questionnaire for User Interaction Satisfaction On-Line Tutorial (OLT) http://lap.umd.edu/q7/QUIS.html

Managing Educational Web-Dependence

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Abstract: The increasing trend toward reliance on Web-sourced materials in education creates a number of potential difficulties for students and teachers. We identify three key risk areas that impact on students who depend carelessly on Web materials: relevance, validity and plagiarism. In this context, we propose a three-strand response that should enable institutions to manage Web-dependence and make opportunities from potential obstacles. The strands of response lie with technological components, institutional re-orientation and curricular focus. When combined, these three sources of response promise a constructive strategy for managing Web-dependence in higher education.

1. Introduction

The ready availability of seemingly relevant materials on the World Wide Web is an apparent boon to students and academic staff. On the one hand, students faced with hand-in deadlines, the need to prove independent study, or even to resource group projects, see the Web as a repository of knowledge and a valuable resource of pre-processed insights. A presumption of material relevance is nurtured by the preponderance of Web portal sites that serve as jumping off points for related links or sites that present their links in a subject-based hierarchy (e.g., www.yahoo.com; www.altavista.com). Such convenient classification schemes belie the prospect that the associated materials may be less than pure in their relevance or insight. Similarly, current search engine technologies provide easy collation of materials that match selected combinations of keywords. Search engine Web sites commonly rank top on scales of frequently visited sites and are often the recommended launch point for investigations on the Web.

From the perspective of curriculum development and course resources, teachers often see the Web as a convenient and cost-effective means of filling material needs or providing direction on content and coverage. (This is substantiated by personal experience and evidence from the proceedings of conferences addressing Web applications and their use in education.) Cursory investigation of course Web sites show frequent use of 'associated links' by teachers. This often replaces or extends the more traditional use of supplementary reading lists.

On the other hand, resort to easily sourced and polished material positively contributes to plagiarism and erosion of intellectual integrity, while the sheer volume and diversity of available materials makes plagiarism detection a hit or miss affair. Evidently, the allure of Web-based knowledge resourcing will not readily disappear.

This paper describes the context of educational Web-dependence and concerns that arise from an over-reliance on Web-based resources. As a prospective teaching and learning aid, the Web's economical and easy access does much to attract the intellectually enquiring and the intellectually challenged. We consider the potential for using unmanaged Web resources in a teaching context and propose a three-strand strategy for managing such Web-dependence, whereby the benefits can outweigh the threats from such reliance.

2. The Problem Scenario

In our view, there are problems and potential concerns arising from reliance on Web-based materials that affect the teacher, as there are others that directly affect the student. In what follows, we attempt to *cast light on those issues that we regard as most salient for their potential impact on the educational and* pedagogical process.

A measured grasp of the student perspective requires an appreciation of the demands and pressures faced by individuals in their student role. Primarily, students face a need to satisfy course demands for assignments or project content. Examination performance is likely to be less directly affected by the influence of Web-sourced materials than other coursework. This reflects the fact that most examinations require student familiarity with materials previously covered in class. New knowledge or novel insights are seldom required (or expected) for successful exam performance.

Easy accessibility of Web-based materials provides a seductive means of satisfying many course demands. Three student-centred problems are consequent upon this strategy. Firstly, materials sourced from the Internet should be accurately focussed on the specific requirements of a student's course. For instance, the need for insights or factual information on the War of the Roses may be satisfied poorly by readily available information on the lives of English monarchs. In other words, there is an issue over *degree of relevance.*

A second problem faced by the Web-resourced student is the veracity of the obtained material. Without further corroboration, the student has no reasonable means of adjudging the validity of the information obtained. Often, the learner is sufficiently challenged by the direct demands of the coursework without addressing the additional burden of substantiating third-party resources.

Having secured putatively relevant materials, the student faces a dilemma over use of this resource. On the one hand, the 'borrowed' information may satisfy immediate course assignment needs. On the other hand, using the material as it stands, without modification and acknowledgement of its true origin, is an act of plagiarism (assuming that the assignment requires original student work.)

In summary, a student using Web-based resources faces three dangers. Firstly, that the selected material may lack the precision required to satisfy the course demands (*degree of relevance*). Secondly, the credibility of such information (i.e., *the measure of validity*) may be difficult to determine, given the time constraints and capabilities of the student. Thirdly, naively employing Web-resourced material without alteration or acknowledgement may vitiate the student's likelihood of success (*plagiarism*).

Against these risks, easy access to seemingly relevant and easily re-used electronic copy may always incline significant numbers of students to tread the path of least resistance and use Web resources to meet their immediate course needs.

The implication of this situation is that students risk being disadvantaged by over-reliance on materials that they have not authored, not modified or have not fully understood. By the same token, teachers face a great challenge if they strive to identify work from such origins. This suggests a scenario in which the system applies techniques directed toward educating students, while students seek simple routes through the pedagogical devices placed in their path. We may disdain such student strategies on the assumption that they will result in lower levels of student development, either in knowledge, skill or related intellectual capacities. Furthermore, knowingly employing such tactics may itself be regarded as reprehensible.

In the face of these polarized views, we will suggest that such educational Web-dependence need not be disadvantageous, either to students or teachers. On the contrary, we propose that careful management of the educational process can accommodate such dependence in a manner that affords enriched curricular development and enhanced learning.

3. Obstacles and Opportunities

The ready accessibility of Web-resourced materials places students and teachers in difficult or tenuous situations. We have characterised three dangers faced by student reliance on such resources. The material may lack the precision required to meet course requirements, the credibility of the information may be indeterminate and students may (naively or otherwise) attempt to pass off third-party material as their own work. We regard these features (degree of relevance, measure of validity and plagiarism) as core shortcomings of Web-dependence. Any viable response must successfully diminish these risks.

We propose a three-strand response that would enable educational institutions, staff and students to live more comfortably with the apparently difficult context of Web-sourcing.

The origin of our problem is essentially technological - ready Web accessibility. Accordingly, part of our proposed response is also technological in nature. As befits large institutions, many problems lie in the managerial approach to the issue of Web-dependence and the perceived role that universities should fill. Finally, we maintain that a revised perspective on the curriculum is an essential component to enable constructive use of the situation. Our three prongs provide a combination of perspectives that jointly enable a balanced and managed approach, thereby seeking to convert obstacles to opportunities. The main ingredients have the following nature:

- technological;
- institutional;
- curricular.

3.1 The Role of Technology

The problem of resource content quality does not support an immediate solution. Indeed, the issue of relevance may never be fully managed since a degree of personal judgment will always be required. Nevertheless, support is available through reliance on accurate indexing and keyword schemes, such as the application of standard Meta tags to characterise document content (cf., Thiele, 1998). As noted by Weibel and Lagoze:

> "The association of standardized descriptive metadata with networked objects has the potential for substantially improving resource discovery capabilities by enabling field-based (e.g., author, title) searches, permitting indexing of non-textual objects, and allowing access to the surrogate content that is distinct from access to the content of the resource itself." (Weibel and Lagoze, 1997)

The envisaged improvement in 'resource discovery' is precisely the possibility of accurately locating relevant materials for a given topic. Such Meta data enhancements are one step toward improved relevance management. Additionally, conventional Web-search and association facilities may soon be enhanced through powerful context-sensitive trawling and data mining approaches (cf. Brin and Page 1998 and Chakrabarti et al 1999). The technological underpinnings are increasingly available to mitigate the problem of relevance.

Just as relevance can be addressed at a technical level, so can validity of third-party materials. Essentially, the student and the teacher wish to ensure that any Web-sourced materials are trustworthy. In other words, that relevance and validity are ensured. This situation parallels the credibility issue with regard to printed publications. How do we ensure the integrity of books, journals and magazines? There are essentially two mechanisms to achieve such credibility. Firstly, we trust publications according to their source. Reputation grants confidence in the materials. Secondly, we trust publications that are commended to us by individuals or institutions whose integrity and judgement we respect.

In the context of publicly available Web materials, there is no tradition, no sustained experience that has passed into our culture. Consequently, we lack the 'reliability infrastructure' that has developed in the arena of paper publications. One might assume that time alone will address this requirement but there is reason to suspect not. The sheer quantity and volubility of publication sources on the Web means that many potentially valuable resources may never build sufficient reputation to be taken seriously.

The second source of trust for paper publications relies upon third-party recommendation. This suggests that universities may fill a need in providing certification for third-party materials. Although the institution may not itself produce these materials, it can nevertheless employ its reputation and serve as a guarantor. For paper-based materials, this approach has precedent in the rise of university publishing houses. Elsewhere in computing, we find the need for such validation addressed through use of digital certificates. Certificates are based on public-key encryption technologies and provide a means of validating documents, both in terms of authentication (the true source of a document) and document quality (trustable content). Thereby, we have a technical means of delivering validated information to the remote user's desktop.

A 'trusted third party' (TTP) endorses digital certificates. The TTP serves as a certificate authority (CA) and verifies the identity of the certificate holder. Since such certificates are tamper-proof and cannot be forged, they provide a validation on the integrity of the information supplier (cf. Feghhi et al, 1999; Tremblett, 1999; Ford, 1998). We will return to the role of university as CA in the following section.

A divergent approach that may also lend itself to integrity validation for third-party resources is the use of software agents and 'access control methods' (cf., Jaeger et al, 1999). While promising, such techniques would require considerable enhancement in order to accommodate content validation beyond mere secure local execution.

Our final student risk was the issue of plagiarism. This too can be addressed at a technical level. If we assume that unattributed use of Web-sourced materials is a likely and undesirable prospect, we can adopt programmatic means to detect such activity (e.g., Whale, 1990; Cunningham & Mikoyan, 1993). Allied to this is the need to ensure that students are made aware that plagiarism is detectable, will be sought and that appropriate penalties will be assigned.

3.2 The University Role

Traditional university learning is teacher centred. In the context of increasing application of teaching technologies, the focus is likely to shift from the teacher to the student. In addition, the manner of teaching material production itself must accommodate changes in the technological infrastructure, especially when targeting network-based delivery and sourcing of materials (Ferguson, Weir & Wilson, 1999). The contrast between the university role of content generator and content importer is highlighted by Tsichritzis (Tsichritzis, 1999), who notes that universities are involved in three functions: production programming and distribution:

> "Compare this situation with TV and how it has evolved. TV networks had initially grouped all three functions (production, programming, distribution). Now they realize it is best to separate the functions and treat them independently. Content is bought from production companies in a competitive manner. Packaging is done by the networks. Finally, distribution is done by local operators." (op. cit., p.95)

Tsichritzis stresses the need for universities to adapt to the current technological context, especially with regard to third-party resources (and consequent 'market forces'. This point works two ways. Firstly, academic institutions must be increasingly willing to outsource content production. Secondly, the same institutions may thrive by offering their services as content providers to other parties. Essentially, the content production and content delivery roles become unbundled. Once the provision of content has been accepted as a separable role for educational institutions, they will focus acutely on issues of quality, relevance and reliability. In turn, these institutions may seek a status equivalent to Certificate Authorities (CAs), but with regard to content quality and not merely authentication of document origin.

A further institutional contribution - well underway in many quarters - is the wholesale adoption of the distributed delivery of teaching content (e.g., through expansion of 'virtual universities'). This is an essential component of the required infrastructure for content certification, content outsourcing, and content provision to flourish. These are the major roles to be played at the institutional level to secure effective management of future teaching and learning.

3.3 Curriculum Approach

Our final strand in the management of Web-dependence affects the manner of curriculum development and delivery in higher education. While most of the risks described early in this paper can be significantly ameliorated through action at the technical and institutional level, much can be done at the curricular level to ensure that students are adequately directed in their study.

Several enabling concepts become important to the nature of the curriculum if we wish to minimise the risks of Web-dependence and maximise the benefits of Web deployment. In the first place, relevant course work must focus on 'experiential learning' (Lewin, 1975), not merely the students' provision of answers to set tasks. In many contexts, the *procedure* that students must employ to reach an objective is of greater learning significance than the objective itself. This distinction is sharply formed by Hansen:

> "The distinction between an academic and utilitarian curriculum can be described as the difference between having knowledge [academic] and being able to demonstrate or apply that knowledge [utilitarian]. Learners in school settings are asked to demonstrate retention of factual information (i.e., short term knowledge, through tests, exams, quizzes, or some form of recall). Do they get a chance to apply that knowledge?" (Hansen, 1995).

A further significant curricular contribution lies in the constructive core use of Web resources. The more that Web materials are deployed as a common component in coursework, the more comfortable and proficient will be the student users. Such training becomes an essential mechanism for familiarisation with the Web, its strengths and weaknesses.

Special focus may be required to ensure that students are acquainted with the nature and risks of plagiarism. Furthermore, artificial constraints on the resources available for specific coursework may be a productive means of eliminating some features of plagiarism (specifically, the passing off of Web-resourced materials). For example, a class assignment may restrict the students to the use of a specific limited set of Web resources and also require that each component in the student's submission identify the source of the insight. Such student facilities are equally important as a skill set as the ability to recall information and report factual details. These are a range of the contributions that can be made at the curricular level in order to manage positively the impact of Web-dependence.

4. Conclusions

The increasing trend toward reliance on Web-sourced materials in education creates a number of potential difficulties for students and teachers. We have identified three key risk areas that impact on students who depend carelessly on Web materials: relevance, validity and plagiarism.

In this context, we have proposed a three-strand response that should enable institutions to manage Web-dependence in order to make opportunities from potential obstacles. The strands of response lie with technological components, institutional re-orientation and curricular focus. When combined, these three sources of response promise a constructive strategy for managing Web-dependence in higher education.

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WEB RESEARCH: The Excite Study

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Abstract: Our paper reports selected findings from an ongoing series of studies analyzing large scale data sets containing queries posed by Excite users, a major Internet search service. The findings presented report on.: (1) queries length and frequency, (2) Boolean queries, (3) query reformulation, (4) phrase searching, (5) search term distribution, (6) relevance feedback, (7) viewing pages of results, (8) successive searching, (9) sexually-related searching, (10) image queries and (11) multi-lingual aspects. Further research is discussed.

INTRODUCTION

Web searching services are now everyday tools for information seeking. A growing body of large-scale, quantitative or qualitative studies exploring the effectiveness of Web search engines (Lawrence & Giles, 1998) and how users' search the Web (Silverstein, Henzinger, Marais & Moricz, 1999). Our paper reports selected results from a major and ongoing series of studies of Web users' searching behavior on the Excite search engine [http://www.excite.com] and a diverse range of information and computer scientists.

A series of studies examined three sets of transaction logs of Excite users' searches containing: (1) 30 billion queries, (2) 51,473 queries, and (3) 1.2 million queries.

Excite Data Set 1 - 30 Billion Queries: Transaction log data collected and statistically analyzed by Excite researchers from 1996 to 1999 (Xu, 1999). As Excite currently processes over 30 million queries per day - the data analyzed included nearly 30 billion queries.

Excite Data Sets 2 & 3 - 51K and 1 Million+ Queries; Transaction log analysis by Spink, Wolfram, Jansen and Saracevic (2000) of over 51K and 1,025,910 queries (by 211,063 Excite users, containing 2,216,986 terms) collected on 9 March 1997.

Users were anonymous and could not be identified in any way. But, we could identify each user's sequence of queries. Excite searches are based on the exact terms that a user enters in the query, however, capitalization is disregarded, with the exception of logical commands AND, OR, and AND NOT. Stemming is not available. Search results are provided in ranked relevance order. A number of advanced search features are available.

Our studies has largely focused on three levels of analysis - *sessions, queries* and *terms*. Each transaction record contained three fields. With these three fields, researchers were able to locate an Excite user's initial query and recreate the chronological series of actions by each user in a session: *Time of Day:* measured in hours, minutes, and seconds from midnight of 9 March 1997; *User Identification*: an anonymous user code assigned by the Excite server; *Query Terms*: exactly as entered by the given user.

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[1] This study was conducted when Jack Xu was the Senior Manager of Search Technology at Excite@Home Corp. Jack is currently the Chief Technology Officer at Netease.com, Inc.

This is a large scale study of Web searching and our findings provide insights into Web searching with implications for developing better search engines and services.

SELECTED FINDINGS

Selected findings from our analysis are summarized below provide interesting insights into Web searching, including: (1) queries length and frequency, (2) Boolean queries, (3) query reformulation, (4) phrase searching, (5) search term distribution, (6) relevance feedback, (7) viewing pages of results, (8) successive searching, (9) sexually-related searching, (10) image queries and (11) multi-lingual aspects.

QUERY LENGTH AND FREQUENCY

- Mean length of Excite queries increased steadily for the years 1.5 1996 to 2.6 1999.
- Mean number of terms in unique queries was 2.4.
- Mean query length for US/UK users in 1996 was 1.5 and mean query length for European users in 1997 was 1.5 - for 1999 US/UK users 2.6 and European users 1.9. English language queries increased in length more quickly than European language queries.

Jansen, Spink and Saracevic (2000) report that Web queries are short and most users did not enter many queries per search. The mean number of queries per user was 2.8 in 1997. However, a sizable percentage of users did go on to either modify their original query or view subsequent results. On the average, a query contained 2.21 terms in 1997. About one in three queries had one term only, two in three had one or two terms, and four in five had one, two or three terms. Fewer than 4% of the queries were comprised of more than 6 terms.

USE OF BOOLEAN QUERIES

- Boolean operators (AND, OR, NOT, +, -) increased from 22% of queries in 1997 to 28% of queries in 1999.
- From 1996-1999 data set, approximately 8% of searches included proximity searching.

Jansen, Spink and Saracevic (2000) found that Boolean operators were seldom used. One in 18 users used any Boolean capabilities, and of the users employing them, every second user made a mistake, as defined by Excite rules. The '+' and '-' modifiers that specify the mandatory presence or absence of a term were used more than Boolean operators. About 1 in 12 users employed them. About one in 11 queries incorporated a '+' or '-' modifier. But a majority of these uses were mistakes (about two out of three).

QUERY REFORMULATION

Spink, Jansen and Ozmultu (in press) found that most users searched one query only and did not follow with successive queries.The average session, ignoring identical queries, included 1.6 queries. About two in three users submitted a single query, and 6 in 7 did not go beyond two queries.

PHRASE SEARCHING

Phrases (terms enclosed by quotation marks) were seldom, while only one in 16 queries contained a phrase - but correctly used.

SEARCH TERM DISTRIBUTION

Jansen, Spink and Saracevic (2000) report the distribution of the frequency of use of terms in queries as highly skewed. A few terms were used repeatedly and a lot of terms were used only once. On the top of the list, the 63 subject terms that had a frequency of appearance of 100 or more represented only one third of one percent of all terms, but they accounted for about one of every 10 terms used in all queries. Terms that appeared only once amounted to half of the unique terms.

USE OF RELEVANCE FEEDBACK

Relevance feedback was rarely used. About one in 20 queries used the feature *More Like This*. Spink, Jansen and Ozmultu (in press) found that a third of Excite users went beyond the single query, with a smaller group using either query modification or relevance feedback, or viewing more than the first page of results. They examined the occurrence of each query type (unique, modified, relevance feedback, view a results page, etc.) in a large sample of user sessions. The distribution of query type changes as the length of the user session increase. For the user sessions of two and three queries, the relevance feedback query is dominant.

As the length of the sessions increase, the occurrences of relevance feedback as a percentage of all query types decreases. 63% of relevance feedback sessions could be construed as being successful. If the partially successful user sessions are included, then more than 80% of the relevance feedback session provided some measure of success.

VIEWING PAGES OF RESULTS

Xu (1999) reported that from 1996 to 1999, for more than 70% of the time, a user only views the top ten results. On average, users viewed 2.35 pages of results (where one page equals ten hits). Over half the users did not access result beyond the first page. Jansen, Spink and Saracevic (2000) found that more than three in four users did not go beyond viewing two pages.

SUCCESSIVE SEARCHING

Spink, Bateman and Jansen (1999) conducted an interactive survey of over 300 Excite users and found that many had conducted two searches, or three or more related searches using the Excite search engine over time when seeking information on a particular topic. Successive searches often involved a refinement or extension of the previous searches as new databases were searched and search terms changed as the Excite users understanding and evaluation of results evolved over time from one successive search to the next.

SEXUALLY-RELATED SEARCHES

Jansen, Spink and Saracevic (2000) found searching about sex on Excite represents only a small proportion of all searches. When the top frequency terms are classified as to subject, the top category is Sexual. As to the frequency of appearance, about one in every four terms in the list of 63 highest used termscan be classified as sexual in nature. But while sexual terms are high as a category, they still represent a very small proportion of all terms. Many other subjects are searched and the diversity of subjects searched is very high. See Spink and Ozmultu (forthcoming).

IMAGE SEARCHING

Goodrum and Spink (1999) conducted a specific analysis of image queries within the 1.2 million queries. Provisions for image searching by Web search engines is important for users.Users seeking images input relatively few terms to specify their image information needs on the Web. Users seeking images interact iteratively during the course of a single session, but input relatively few queries overall. Most image terms are used infrequently with the top term occurring in less than 9% of queries. Jansen, Spink and Saracevic (2000) found that many terms were unique in the large data sets, with over half of the terms used only once. Terms indicating sexual or adult content materials appear frequently in image queries. They represented a quarter of the most frequently occurring terms, but were a small percentage of the total terms.

MULTILINGUAL SEARCHING

Xu's (2000) analysis of 634 million web pages shows a 28 language corpus - most of the Web is English language with an increasing amount of web sites in Japanese, German, French, Italian and Chinese, Spanish, etc. Multilingual retrieval techniques will be at the forefront of IR research for the foreseeable future (Xu, 2000).

DISCUSSION

Our ongoing study of Web searching has studied a number of large scale Excite transaction logs. We specifically report results from three related studies of the Excite query corpora. Our studies, using large scale log data, can answer some interesting questions about Web searching, but cannot address the results of users' queries or assess the performance of different search engines. However, our analysis does provide a snapshot for comparison of public Web searching that can help improve Web search engines and services. We conclude from our analysis that most Web queries are short, without much modification, and are simple in structure. Few queries incorporate advance search techniques, and when they are used many mistakes result. However, relevance feedback and advanced search features are growing in use. People retrieve a large number of Web sites, but view few result pages and tend not to browse beyond the first or second results pages. Overall, a small number of terms are used with high frequency and many terms are used once. Web queries is very rich in subject diversity and some unique. The subject distribution of Web queries does not seem to map to the distribution of Web sites subject content. Web searching is a huge public challenge, but an imprecise skill.

Organizations and individuals are spending increasing amounts of time working with electronic information. However, many Web interactions are often frustrating and constrained. To support human information behaviors we are seeing the development of a new generation of Web tools, such as Web meta-search engines, to help users persist in electronic information seeking is needed to help people resolve their information problems.

FURTHER RESEARCH

Our paper has provided a selected overview of results from a large-scale and ongoing series of Web searching studies. For further results and details from the specific analyzses mentioned above, readers should consult the following individual papers in the reference list below. Ongoing analyses is being conducted in the following areas:

- *Queries characteristics* - Wolfram (2000)
- ***Multimedia searching*** - Jansen, Goodrum and Spink (forthcoming)
- *Linguistic aspects of queries* - Jansen, Spink and Pfaff (forthcoming)
- *Term co-occurrence* - Ross and Wolfram's (in press)
- *Queries in elicitation form* - Spink, Milchak and Sollenberger (forthcoming)
- *Sexually-related queries* - Spink and Ozmultu (forthcoming)
- *Business-related queries* - Spink and Guner (forthcoming)
- *Analysis of 1997 1 million queries* - Spink, Wolfram, Jansen and Saracevic (2000)

Previous results are currently being compared with results from an analysis of 1.7 million Excite queries to isolate similarities and/or differences in Web searching from 1997 to 1999. In conclusion, continued research into Web user behavior is needed to impact the development of new types of user interfaces and software agents to aid users in better Web searching.

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Adaptive User Interface of a Web Search Engine by Organizing Page Information Agents

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Abstract: In this paper, we develop an organization method of page information agents for adaptive interface between a user and a Web search engine. Though a Web search engine indicates a hit list of Web pages to user's query, it includes many useless ones. Thus a user has to select useful pages with page information indicated on the hit list, and actually fetch the page for investigating the relevance. Unfortunately the page information is insufficient for a user, and which information is adequate depends on a user and a task. Hence we propose adaptive interface AOAI in which different page information agents are organized with user's evaluation. As results, different organizations are achieved depending on a user and a task.

1 Introduction

Accessible information through the Internet is increasing explosively as the WWW becomes widespread. In this situation, the WWW is very useful for a user who wants to search and gather information. However there is a significant issue that a user does not know relevant URLs. The practical solution is to use a search engine. A search engine provides a list of relevant Web pages (called a *hit list*) to queries from a user. Unfortunately, since adequate filtering is very hard, many irrelevant Web pages are indicated in a hit list.

Hence a user needs to select relevant pages from a hit list using information indicated on each page, and actually fetch the Web pages to verify the relevance. We call the information on Web pages in a hit list *page information*. Unfortunately the page information like a title, the size and head sentences is fixed and neither sufficient nor necessary for a user to evaluate the pages. For example, Fig.1 shows page information in a hit list indicated by *InfoSeek*, one of major search engines, and the page information is significantly inadequate because it lacks important elements like image, not-found, network traffic and so on. However adequate necessary page information depends on a user and a task, hence we hardly design interface with adequate page information in advance. Thus we propose adaptive interface in which different page information agents are organized through human-computer interaction and suitable interface is gradually constructed. The page information agents indicating different information are prepared at first. A user evaluates them through search, and they are organized. As results, adaptive interface (Norcio & Stanley 89) is achieved depending on information utilized by a user and a task. We call this framework AOAI (Agent Organization-based Adaptive Interface).

Pnadit and Kalbag developed an assistant system for operating text on a PC, in which multiple recognition agents are integrated (Pandit & Kalbag 97). Each agent is able to extract different information on URL, phone number, place name from text in a clipboard. When plural agents obtain information and try to indicate them, they are organized into a multi-layered menu. Unfortunately the way to organize them is fixed and the system is not adaptive to user's preference.

Figure 1 Information on a hit Web page by *InfoSeek*

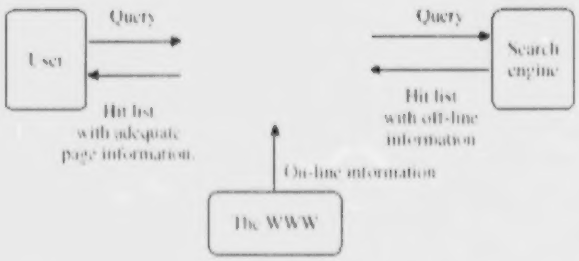

Figure 2 Overview of AOAI.

SATELIT-Agent (Akoulchina & Ganascia 97) distinguishes the expert's profile and offer a special interface to them. It can navigate a user by inferring an analogue of the user's search requirements. Also Maglio and Barrett observed users searching for information in the WWW, and build two personal Web agents (Maglio & Barrett 97). The shortcut agent can identify the repeated search patterns and suggest them for new searches, and the waypoint agent can identify and display the nodes that go together in the history. However these studies could not deal with page information in a Web search engine and not organize interface agents.

2 Overview of AOAI

AOAI is adaptive interface between a Web search engine and a user like shown in Fig.2. AOAI receives queries from a user and gives it to a search engine as it is. Then it obtains the hit list to the queries from a search engine and indicates them to a user with useful information for selecting a page which he/she wants. Note that AOAI deals with the two kinds of page information: off-line and on-line information. The *off-line information* is obtained from a hit list of a search engine, and *on-line information* is obtained from a Web page which was actually fetched on-line. In contrast that the off-line information is quickly indicated and old, the on-line information is slowly indicated and recent. The page information is indicated by each PIA (Page Information Agent) in an IUW (User Interface Window) of AOAI. The followings show a main procedure of AOAI.

1. Giving a query to AOAI.
2. A hit list is indicated on the IUW. Fig.3 shows the initial IUW. When a user points a *target page number* ((A) in Fig.3) which he/she wants by a mouse cursor, all the PIAs indicate page information on the page.
3. Select the Web page which he/she wants with page information from PIAs.
4. Double click the target page number and see it through a Web browser.
5. If the page is relevant, a user evaluates the PIAs whose information contributed to the selection, and organization is done. Otherwise, go to 3 and a user selects other pages. The positive/negative evaluation is done by clicking a right/center button of a mouse on a PIA.
6. This query is finish by pushing "Exit" button ((D) in Fig.3) , and if necessary, AOAI organizes PIAs using the procedure described later. Go to 1 with next query.

A user evaluates PIAs typically when he/she obtained relevant pages. However AOAI allows a user to evaluate them anytime. Thus this evaluation hardly gives cognitive load to a user. Furthermore, for seeing page information effectively, a user can directly manipulate PIAs by drag and drop it anytime, and arrange them as he/she likes. We assume that AOAI should integrate agents which were placed closely by user's direct manipulation.

Additionally to the above procedure, a user is able to deconstruct an integrated PIA by drag&drop it on the factory icon ((B) in Fig.3). Also after embedding, a user can decompose embedded agents by clicking a trash box icon.

Figure 3 Interface window (initial state).

3 Page Information Agents

AOAI provide 12 PIAs like the followings. Every agent is designed and implemented in advance. An agent has human-like appearance which changes depending on the growth value mentioned later and a balloon in which a message from the agent to a user is indicated. Some agents indicate the off-line information and other agents indicate on-line information with " Now". A user can utilize any of them.

- **URL agent:** This shows the URL of a target page obtained off-line.
- **Traffic agent:** This agent investigates the traffic on network connection to a target page on-line. It shows "Server down", "Light", "Heavy" depending on the response.
- **Title agent:** This shows the title of a target page obtained off-line.
- **Title Now agent:** This shows the title of a target page obtained on-line.
- **Head agent:** This stands for the first sentence of a target page off-line.
- **Head Now agent:** This stands for the first sentence of a target page obtained on-line.
- **Precision agent:** This shows the rate of precision obtained off-line.
- **Size agent:** This agent investigates the size of a target page off-line.
- **Size Now agent:** This agent investigates the size of a target page on-line.
- **LMD agent:** This agent indicates the last modified date obtained off-line.
- **LMD Now agent:** This agent indicates the last modified date of a target page using a similar on-line way to a file-size agent.
- **Image Name agent:** This shows the file name of the image investigated on-line.
- **Image agent:** This directly indicates an image in a Web page.

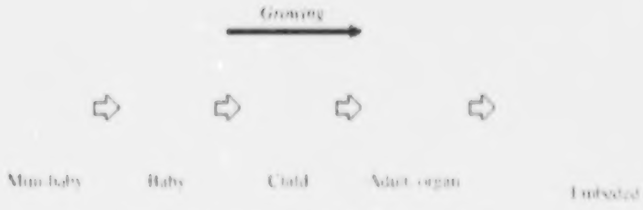

Figure 4 Growing character for each stage.

4 Organizing Page Information Agents

4.1 Agent Properties

A PIA A_i has the following properties on organization and itself activity.

- **Growth** G_i **:** This property indicates A_i 's activity of which is increased/decreased by human evaluation. A method to compute G_i will be described in the next subsection. This property is used for growing of a PIA.
- **Stage** S_i **:** This takes seven values indicating A_i 's stage: *trash*, *mini-baby*, *baby*, *child*, *adult*, *organ* and *embedded* depending on the growth G_i . The appearances are shown in Fig.4. An agent grows from baby to adult, and finally is embedded into a hit list, where an agent disappears and only its page information is indicated. A PIA in a trash stage is moved into the trash box icon ((C) in Fig.3).
- **Page information** I_i **:** This is a list of page information which A_i indicates.
- **Position** $P_i(x, y)$**:** Position (x, y) of an agent A_i in a window is used for computing the distance D_{ij} between an agent A_i and an agent A_j .

4.2 Human Evaluation and Growing Page Information Agents

In AOAI, PIAs are organized by human evaluation. The growth G_i is updated by a user's click using the following formula. Since this G_i is computed temporally within last 10 searches, not cumulatively, AOAI is adaptive to the change of the domain in which a user wants information, and this is experimentally verified in section 5.2.

G_i = (No. of positive eval. in last 10 searches.) _ (No. of negative eval. in last 10 searches.)

We define *growth threshold* ψ_G and *decline threshold* ψ_E for controlling the growth of PIAs. When the G_i becomes more/less than ψ_G / ψ_E , PIA A_i grows/declines into the upper/down stage with resetting $G_i = 0$. However the embedding needs a special procedure mentioned later.

In addition to integration, AOAI provides a way to eliminate useless PIAs. It eliminates a *mini-baby* agent A_i with G_i is less than an ψ_E into the trash box. As results, useful PIAs survive and useless ones disappear in a UIW.

4.3 Organization Procedure

The *relation* R_{ij} between two PIAs A_i and A_j is constructed when the following precondition is satisfied. This condition means that the two *organ* agents are closed within ψ_D . As mentioned before, seeing page information effectively, a user is able to directly manipulate PIAs anytime, and arrange them as he/she likes. Thus we assume that AOAI should integrate agents which were placed closely by user's direct manipulation. We introduce ψ_D *distance threshold* for controlling the organization. As ψ_D and ψ_G are small, agents tend to be organized quickly. The D_{ij} is a mean distance between A_i and A_j for last 10 searches.

$(D_{ij} < \psi_D)$ _ $(S_i = organ)$ _ $(S_j = organ)$

We use undirected graph representation for organizing PIAs. The nodes and arcs correspond to agents and constructed relations. In the graph, groups of PIAs to be integrated are determined by investigating maximal connected sub-graphs. Note that we do not use maximal cliques because they are too restricted. Since we can apply depth-first search to extract maximal connected sub-graphs, the computational cost for extracting all the groups is $O(n)$

Figure 5 Growing agents. Figure 6 Agent integration. Figure 7 Embedded agents.

where n is the number of agents, and this is sufficiently fast to AOAI. When organization is done, the new agent A_k integrated of agents $A_i \cdots A_j$ has a balloon including all of the $I_i \cdots I_j$ and starts as baby having $G_k = 0$. As organization is progress, useful PIAs are gradually integrated into a single one. When all the useful agents are organized into a single agent A_t, it is embedded into a hit list and I_t is indicated in the list.

We have been fully implemented AOAI using JAVA. First of all, a user input a query to AOAI. Fig.3, Fig.5, Fig.6 and Fig.7 show the executed examples of AOAI with a query "AI interface agent". Fig.3 stands for an initial AOAI having all of the 12 PIAs. As seeing from the figure, all the agents are initially babies. In Fig.3, the check box in the left side of a target page number is checked when all the on-line information on the page is obtained. A user moves a cursor on a Web page number and PIAs indicate own information on it in their balloons. A user investigates information on each Web page number and double-clicks the Web page number which he/she wants to actually see the page through a browser. After repeating this process, a user finds a relevant Web page and evaluates PIAs.

As the agents get user's evaluation, they become "child" and "adult". Fig.5 shows the scene in which the five agents agents got "child" and two agents were already eliminated. In Fig.6, the two groups of "organ" agents satisfied the condition of organization and they are organized into two "baby" agent having their integrated page information in their balloons. Finally the single PIA made of Title, Traffic and Head agents survived and was embedded into a hit list like Fig.7.

5 Experimental Evaluation

We made three types of experiments for evaluating AOAI. For all the following experiments, the growth, decline and distance threshold were experimentally set 10, -3 and 200 pixels. Also we used *infoseek* as a search engine of AOAI for all the experiments.

5.1 Exp-1: Various Embedded Agents

If every user utilizes the same page information for finding relevant Web pages, AOAI does not need to be adaptive to a user and we can design interface using the common page information in advance. Thus we first investigate whether users use different page information in a hit list. This is examined by variation in embedded agents for each user. We made experiments in which nine subjects (master course students) freely used AOAI and embedded agents are obtained finally. Table 1 shows the results. The mean time and the mean number of searches until embedded were 165 sec. and 9, respectively. As seeing from this table, subjects embedded agents differently and no PIA embedded for all the subjects. This results supports that AOAI needs to be adaptive to users.

5.2 Exp-2: Adaptation to the Change of a Task

Next experiments are on adaptation to the change of the domain in which a user wants Web pages. We gave four subjects the four domains ("programming", "technical paper", "prize" and "image") sequentially and they searched information on the domains. We consider the change of the domain the change of a search task. When the agents were embedded in a domain, the next domain is given to a subject. As results, we observed that all the subjects embedded agents in a domain, decomposed them for adaptation to the new search task, and embedded them again. Thus a user can be adaptive through AOAI to the change of a task.

Sub	Embedded agents	Sub	Embedded agents
S1	URL,Tr,Ti,Head_Now,LMD,Im	S6	URL,Ti,Ti_Now,Head,Head_Now,Im
S2	URL,Ti,Head,Im,LMD,Im_Name	S7	Ti,Ti_Now,Head,Head_Now
S3	Tr,Ti,Ti_Now,LMD,Im,Im_Name	S8	URL,Tr,Ti,Ti_Now,Head,LMD,Im,Im_Name
S4	URL,Ti_Now,Head_Now,Precision,Im	S9	URL,Ti,Ti_Now,Precision,Im
S5	Tr,Ti_Now,Head_Now,Precision,Im		

Table 1 Embedded agents for each subject.

Domain	Time (sec.)		# of Web pages	
	AOAI	*Infoseek*	AOAI	*Infoseek*
program	261(158)	475(339)	4.4(2.61)	13.4(8.0)
paper	219(153)	330(279)	2.6(2.2)	11.8(10.4)
prize	551(713)	546(654)	5.9(7.4)	5.5(5.8)
image	207(115)	381(640)	1.7(1.1)	9.8(14.4)
Average	298(367)	411(509)	3.4(4.1)	9.1(10.7)

Table 2 The results for Exp-3

5.3 Exp-3: Comparison with a Search Engine

Finally we compared AOAI with embedded agents with a search engine *infoseek*. We used two subjects for each of "programming", "technical paper", "prize", and three subjects for "image", and investigated the the averages of search time and the number of Web pages seen by a subject until relevant Web page was found. The results are shown in Table 2. The bracketed number stands for standard deviation. Though the search time of AOAI is less than that of a search engine in average, the difference is not statistically significant by *t*-testing. However the difference of the number of Web pages seen by a subject is statistically significant, and AOAI outperforms a search engine over two times. Since seeing Web pages is hard cognitive load for a user, we conclude the cost of AOAI for a user is significantly less than that of a search engine.

6 Conclusion

We proposed AOAI: adaptive interface in which different page information agents are organized through man-machine interaction. In AOAI, the page information agents indicating different information on a hit list like file-size, network traffic and a page title are prepared at first. A user evaluates them through a use of a search engine, and they are organized based on the evaluation. As results, different organization is achieved depending on a user and a task. By making experiments with subjects, we found AOAI was promising adaptive interface for providing adequate page information in a hit list.

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The Design Space for Web User Awareness

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Abstract: The richest information resources of the World Wide Web (WWW) in addition to suitable network infrastructure enable its use as a human interactive foundation. Mutual awareness between users, as a kind of consciousness and understanding of others, is crucial for such human interaction. In this paper, the mechanisms to support user awareness on the WWW are presented from three aspects: server techniques, client techniques, and third party applications. The underlying techniques and the pros and cons of each aspect are analysed. This paper illustrates the potential importance of user awareness support, and the need for more attention and further development in electronic commerce systems.

1. Introduction

Electronic commerce (EC) is becoming an increasingly important aspect of business all over the world. The World Wide Web is rapidly being populated with documents that promote products and services, as businesses scramble to enter the electronic marketplace. User communication is an important topic when we seek to attract people to stay on a specific EC web site. "The cost of acquisition [of 'eyeballs'] is huge, and carries no guarantee that people will stay once they discover this site is just more... ad banners and sticky upbeat 'kontent'. The effective means is human conversation, interaction, and unfiltered, unsterilized communication. That's the nature of the net." (Locke 2000). EC needs easy-to-use on-line facilities for user communication, including synchronous tools like chat rooms and asynchronous tools like bulletin board systems.

Studies show that web users in general have an inclination for interaction and on-line conversations. Searchwords (SearchWords 2000) puts "chat" and "ICQ" on their top-ten list (5th and 6th) of popular search words on the web. Also CNET News reported (April 21, 1999) that the Mozilla group (under America Online) would concentrate on online chat tools and system development. AOL already owns ICQ, an Internet communication tool with the largest worldwide user group. There are other communication tools such as Microsoft NetMeeting and Netscape Instant Messager. However, all these tools lack facilities to work within the context of web pages or sites. They require users to enter a specific on-line "chat place" to communicate with the others, and provide inadequate facilities to guide user communication within the web itself, i.e. on a web page neither awareness of others, nor communication with others are supported. An active "web based" user communication means that communication should take place within the web site rather than a designated "chat place". In current applications, people are not aware of each other when surfing on the web. To achieve communication or conversation on the web we need to have user awareness support. In this paper I try to give a comprehensive analysis on the implementations of user awareness in three types of design spaces, and propose a design guidance to support user awareness that could improve user communication on the web.

2. User Awareness on the Web

Web users browse (i.e. "enter") web pages which are created independently of users' physical locations, and interact asynchronously or semi-synchronously on pages through the web server. However, it is impossible for an individual user to participate in a session on the web where people negotiate and share documents because of the lack of awareness of the others and their actions. Thus it is not only technically complex actions, like pointing and talking, that cannot be supported. Even a simple representation of other users on the same page cannot be easily done with web technologies. Lack of mutual user awareness is one main shortcoming of current web-based interactive systems.

"When you go to a web site, you are alone,... When you go to places in real life, you expect people to be there" (Oakes 1999).

The major problem of communication identified by CSCW research is of maintaining awareness between remote people when changes in human activities or changes in information resources occurring in one location effect activities in another. Awareness has long been a recognised phenomenon that refers to the degree of accuracy by which one's perception of his current environment mirrors reality (Adams, Tenney et al. 1995; Gilson 1995). Awareness is defined as an adaptive, externally directed consciousness (Smith and Hancock 1995). It is a facet of consciousness and generates purposeful behaviour in a situation. The phenomena of awareness are knowledge about and directed action within an environment e.g. (Smith and Hancock 1995).

Endsley (1995) presented three levels of awareness in terms of perception, comprehension and projection. Perception is to perceive the status, attributes, and dynamics of relevant elements in the environment. Comprehension synthesises the elements on the perception level. It goes beyond simply being aware of the elements that are present to include an understanding of the significance of those elements in light of pertinent goals, contexts or contents. Projection means the ability to project the future actions of the members in the environment, at least in a very near term. The projection level is used usually in specific domains within which group members' action projection is necessary, such as aviation and battlefield applications and affiliated command/control systems. Within the specific web situation, user action projection before communication is currently unnecessary and technically impossible. Perception and comprehension are the basic and major human factors of general requirements for group environments. They are helpful to outline questions relevant to user awareness in specific web application domains.

Table 1 lists the experimental elements of two awareness levels and the corresponding research questions, which can be used to facilitate user communication on the web. These questions identify what users may ask when they are co-located on the same page or site. Of course not all web user ask such questions. However, to a webmaster of an EC site, these generic questions could be interesting and valuable.

Level 1: Perception	Relevant questions
Presence (identification)	Who is here? (in specific web page or site)
Location	Where (which page) are people browsing?
Actions	What are people doing? (this is a situational question which answers may differ and change)
Events of changes	What has changed? (e.g. page contents modified by other users)
Level 2: Comprehension	Relevant questions
Status	Who is here and how long has he/she been here?
Activities	How active are people in some particular pages? (this is a situational question that much depends on how to define activity)
Changes	What changes are people making and when?

Table 1: Elements of awareness in the perception and comprehension level.

In the following, I will work on different design aspects of user awareness support and analyse their pros and cons respectively. I will use a primitive question "the number of online users" as an example to illustrate concrete implementations of user awareness.

2. Web Technologies for User Awareness

Currently there are three different ways to implement support for user awareness: Web server techniques, client techniques and third party applications. Web server techniques use standard techniques to collect awareness information at server side, such as where users are from, and which web pages users are on, and may send the information back to users. The Web server takes responsibility for managing user identifications and session controls. Client techniques adopt other technologies to create user communication channels through web servers. Here the server side is strengthened with extended awareness or communication components and binds them into a whole. Third party applications usually are not designed exclusively for awareness but mainly for communication. They usually provide much more functions than server or client implementations because they can break some constraints of browsers and some limitations of web protocols e.g. HTTP, to obtain more design freedom or space. However, the fatal limitation of these techniques is that they lack any connection between users with the third party application and others. This of course means there is no communication between third-party applications and normal web servers, or clients.

3.1 Web Server Techniques

In order to provide supports for mutual user awareness, applications have to build up an internal channel automatically and smoothly when user communication is requested. A straightforward way is to extend the functionality of existent web server by adding direct awareness query, as web servers can track who and where users are.

Figure 1 shows the Server-based architecture for user awareness. Suppose that *U* is a user's browser, and *S1* is a normal web server. To answer the question, "how many users are on the same page", the server-based mechanism starts at the time that *U* retrieves a web page, which means there is a new user coming on server *S1*. The request then invokes a server-side system "interrupt", e.g. SSI/CGI call, to the awareness module residing in *S1*. Awareness module calculates the number of users and sends the HTML data with the number information back to the browser *U* through the server *S1*. Of course, *U* needs "pulls" (not *S1* "pushes") on the latest awareness information constantly because of the limitation of HTTP.

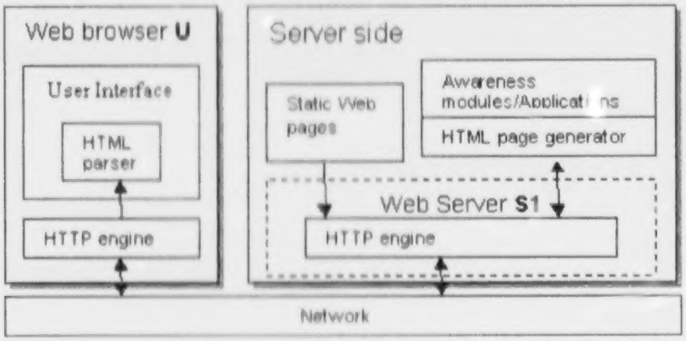

Figure 1: Server-based architecture for user awareness

Here are the strengths and weaknesses of web server techniques.

Strengths	**Weaknesses**
- Server side control: The server takes full responsibility for supporting awareness information and user communication. - Database support: User's registration and profiles are stored in databases at the server side to provide server-based security mechanisms, such as user authorisation, IP identification, and browser identification.	- Limited awareness information: Server techniques can not answer all awareness questions in Table 1 due to current technical deficiencies. There is no way to know when a user leaves a web page. The browser will not say "Good-bye" to server. For awareness support, this is a fatal weakness. - Lack of enough technique standards: Developers must consider different techniques and server platforms, and judge carefully to fit their requirements. Server techniques are normally platform-dependent. - Limited system performance: Server techniques consume server resources and increase server load, because all works are completed at server side. Meanwhile, the system scalability question need also be taken into account carefully.

Using server techniques to answer such user awareness question "how many users are in a specific web page" is not difficult. The simplest implementation can be a segment of Perl script to calculate how many visitors (IPs) in current page. However, the maintenance of user session in different pages is much more difficult than the number counting, because the web protocol lacks the data persistence feature that is essential for the user identification when the user "jumps" among different web pages. For example, the server identifies a user as user *A* in page 1. When he clicks a hyperlink in page 1 and enters page 2, the server must regard him as user *A* rather than a new user. Two approaches of user tracking at server side are used: browser Cookies and URL rewriting.

3.2 Client techniques

Server techniques are necessary but not sufficient. Understanding what client techniques are and how they perform are useful for client user interface design, especially for user awareness representation. Usually people are required to enter a specified on-line "place" and communicate with others, but the on-line "place" fails to provide sufficient context (e.g. the original web pages) to guide users in their communication attempts.

Figure 2 presents the general architecture of awareness implementation using client technologies. A client-based mechanism starts when *U* retrieves a web page. Each web page contains an awareness engine that transfers the user's information between engine and dedicated awareness module/server. The awareness module calculates the number of users and sends it back to client awareness engine. The awareness engine then displays the number of users in browser *U*. Compared with pure server techniques, the client awareness engine can send a user "leaving" message to notify the server about the exact time and the location, which is a remarkable improvement. Meanwhile, the awareness server module is able to "push" updated awareness information to the client and notify the user without supporting from HTTP engine (the dotted arrow line in Server side).

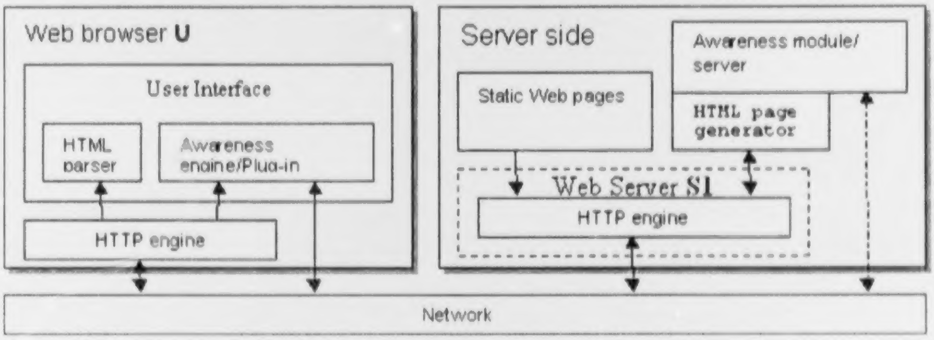

Figure 2: Client techniques for user awareness

Strengths	Weaknesses
- More awareness information: Client techniques provide more awareness information by extending server-based implementations. - Cross-platform features: DHTML promises cross-platform features that enable web pages to be viewed and printed correctly in different systems and monitor resolutions. System designers can use DHTML to provide the same awareness representation interface without worrying about the special factors for different browsers or hardware. - Flexible information illustration: Multimedia information can be used, such as sound effects and animated images.	- Lack of standardisation: DHTML has no clearly defined standard. As a result it degrade the idea of cross-platform. It is easy to write DHTML code that works in one browser but fails in another. Browser dependency: Applications are usually browser-dependent.

Since there are always some connections made between clients and servers, it is impossible for client techniques to support user awareness independent of server side support. Usually web sites combine server-side and client-side techniques to represent user awareness information in multimedia form, for example, use DHTML's Tree control feature to draw the list of web pages with user numbers adjoining, e.g. SPARC system (SPARC 1999); use Java applet to draw graphic user interface (UI), e.g. WAP (Palfreyman and Rodden 1996), WebWho (Ljungstrand 1999), Lotus Sametime Toolkit (Lotus 2000) and Cobrow (Cobrow 1999).

3.3 Third-party Applications

Recently more and more third-party commercial products that support web user interaction have become available in the market, e.g. Gooey (2000), Instant Rendezvous (IR) (2000), uTOK (2000), Odigo (2000), etc. These applications enable equipped visitors to annotate the contents or launch discussions on any web page easily, but they demand that specific client software should to be installed in user's computer beforehand. They complement the services provided by server techniques and client techniques by giving normal end-users the maximal freedom and capabilities of awareness and communication over web pages.

Third-party techniques comprise tools supplying interactive functions, which is out of the control of normal web servers and webmasters due to current technical limitations and security issues. The natural limitation of web protocol is that it is not suitable for synchronous user communication. On the other hand, client techniques like Java applets have so strict security control that the applet can just run inside the browser Java sandbox.

Furthermore, the server-to-client one-way control is tedious. Users are usually constrained and have less freedom from the controls of service providers. Third party tools usually bypass these sorts of man-made controls and provide relatively unrestrained interactive functions over any web sites. For example, the chat function is enabled over different web pages and different sites by Instant Rendezvous.

Figure 3 shows the structure of third-party technique. The key point is that a third-party application is totally independent of web browser. It works independently to collect awareness information and support user communication. To track user actions on specific web pages, a client application must create a "link" to the browser that can inform the client of changes at the browser side including mouse movement, clicks and page switching.

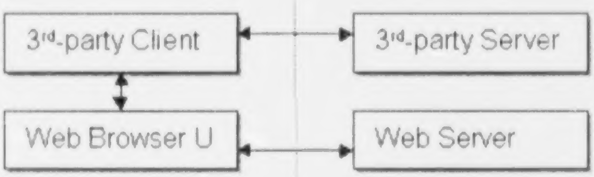

Figure 3: Third-party applications for user awareness.

Strengths	**Weaknesses**
- Breaks the natural limitation of web sites: Equipped users have abilities to interact over different web sites. Usually the third-party tools are very flexible to use, and run as a "browser-mate". - Complement the traditional web services: Third-party applications add real-time interactive features, such as user awareness and communication channel over different web pages and sites.	- No connection to web server: Third party applications use their own servers that cannot (so far) talk to the web servers that the other ordinary users are visiting. - No connection to other ordinary web users: This is inherited from the previous weakness. Users without the third party application are not aware of those with it even when they are looking at the same page or same site at the same time. - Platform-dependent: Product vendors have to create a version of the application for each platform. - Pre-installation required: It is unlikely that web users will download and install plug-ins, as even minor inconvenience will probably not be matched by benefit.

To answer the question, "how many users are on the same page", third party client first creates a link to the working browser. When the browser retrieves a web page from the web server, the third party client captures immediately the page location from the browser and sends it to the third party server. The third party server calculates the number of users from all its clients in this particular page and sends the result back to the client. In this method, the weakness for full information gathering is that there is no direct connection between web server and third party server, but the strength is that the third party client can track any web pages and sites that the browser moves to.

There is one special kind of application under the third-party category: the mobile device/phone. Recently, mobile devices provide new services such as secure corporate data access, e-mail, Internet and EC. WAP (Wireless Application Protocol) is an open standard for applications over wireless networks (WAP 1998). Like the architecture in Figure 3, a third-party server can be denoted a WAP protocol gateway that translates requests from the WAP protocol stack to the WWW protocol stack. A WAP gateway, a middle-ware between client (mobile device) and original web server, overcomes the weakness, i.e. lack of web server connection in third-party category. This is a very interesting future application perspective for the third-party application category.

4. Summary and Conclusion

Server techniques can guarantee the best consistency but have least flexibility and functionality to end-users. Client techniques are medium. Third party applications, on the contrary, can provide the best flexibility and functionality but the least end-user consistency. As a matter of fact, most users visit web pages with ordinary browsers. There is no direct connection between these two sorts of users. They are not aware of each other.

The weakness of sever techniques is lack of flexibility and need for sever-side installations. The weakness of third-party applications is lack of a communication channel with the other two awareness implementations. Moreover, user awareness information provided by third-party applications is partial and incomplete because of the presupposition that mutual awareness is obtainable when and only when both users have the same third-party application installed. Because you can not guarantee every web users are using Instance Rendezvous to communicate over pages. Client-side techniques are favoured when we think about these pros and cons. I believe that client-side techniques will make up the majority of EC market applications, at least in the near future.

Based on the discussions of different techniques that represent user awareness information, Table 3 illustrates answers to questions raised in Table 1. These answers provide a quick impression on the technical capability of supporting two levels of awareness.

	Can this question be answered?		
Relevant awareness questions on Level 1	Server Techniques	Client Techniques	Third-party Techniques
Who is here?	Yes	Yes	Yes
Where (which page) are people browsing?	Yes	Yes	Yes
What are people doing?	N/A	N/A	N/A
What has changed?	Yes	No	No
Relevant awareness questions on Level 2			
Who is here and how long has he/she been here?	No	Yes	Yes
How active are people in the place?	N/A	N/A	N/A
What changes are people making and when?	Yes	Yes	No

Note: *"N/A" means there is no answer for situational questions in general case.*

Table 3: How different techniques can answer awareness questions.

As a caveat, it must be said that it is getting more difficult to classify systems into these categories since more and more systems now are combining server, client and third-party techniques to achieve goals of practicability and flexibility. Such tendency is favourable for a uniform technical infrastructure and information standardisation for user awareness.

"Conversations have always been at the heart of the marketplace, like a commons at the heart of a community. The Internet brings... an ancient market into the 21st Century. The conversations may have nothing to do with commerce per se, but the fact that people are networked and communicating directly has a tremendous impact on corporate marketing assumptions" (Locke 2000). In the same manner, user awareness, as the basis of communication, plays an important role in the EC. It helps vendors comprehend a visitor's presence, availability, intention, and the favourite pages, and further improves the communication between on-line vendors and visitors. User awareness design makes it possible for users interact once they are aware of each other. The analysis in this paper gives such a design reference for user awareness support which provides opportunities to consequently support chance encounters and user communication within the web.

In this paper, User awareness issues are highlighted and analysed from three dependent technical implementations: client, server, and third party. As a basis to support user awareness, user tracking techniques are also described and compared from these three implementation aspects. These techniques can be used independently according to specific user awareness requirements. However, sometimes it is difficult to represent more beneficial user awareness information from just one aspect of implementation. We should study more on the combination of different techniques. In order to

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achieve the maximum functionality to support user awareness, further research needs to be carried out on how to combine them together in specific applications.

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INVITED

The Real Digital Convergence, or why Monster.com Might Own the World

Scott Dynes
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Technology has given us unprecedented access to content. The range of content, coupled with choice of representations, give rise to talk of a digital convergence – our televisions, phones, libraries and computer will all become a single appliance in the living room, capable of displaying all types of content.

This content-centric view misses the real digital convergence. When viewed from a socio-anthropological standpoint, the more profound convergence is that of content, context, and collaboration, which will result in the integration of individuals and their society, processes, goals and content into on-line communities. Members are typically exposed to a greater range of ideas, viewpoints and tools than would otherwise be the case, resulting in unforeseen opportunities for innovation through synthesis of diverse views. This talk will explore this theme, showing several environments used in industry that accomplish this convergence.

CV: Scott Dynes is deeply interested in How Things Work. This has led him to spend time researching things as diverse as molecular clouds in galactic centers, interactive learning environments, the response of auditory nerve fibers to electrical impulses, how to recreate key aspects of stand-up corporate training online, and cesium vapor lasers.

Dynes believes that computers offer two great advantages for conveying knowledge: first, the computer enables users to have access to multiple representations of ideas and content, and secondly, the computer lowers the barriers to accessing relevant information.

These ideas are at the core of the knowledge interfaces of the interactive learning environments he developed: Animated Algorithms (Gloor, Dynes, Lee; MIT Press 1993, and the internet-based environments that allow for natural interactions amongst small groups of people developed as part of his postdoctoral research at MIT's Center for Educational Computing Initiatives.

Following this he co-founded a start-up developing what would now be called a knowledge management environment.

Each of these endeavors play a part in his present role at Communispace, where he tests the hypotheses that 1) training is not learning, 2) that content is not king - interactions are, and 3) communities are necessary but not sufficient for truly productive on-line interactions. This is not done deductively, but proactively - by designing and developing prototypes of communities that integrate many elements to support the needs and goals of the community.

Human Brain Data on the Web: A New Tool for Medical Research

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Recent advances in cognitive neuroscience have made it possible for a new way to use the web: as a tool for medical research in functional and structural human brain analysis, both for treatment and prognosis. Such web-based medical systems are very much needed because of the appearance of new imaging methods that are generating data at very rapid rates, and also due to the Human Brain Mapping initiative [7, 15, 16]. Sharing such data is very important because of the high cost in generating them at each laboratory. The web can provide access to a common set of data and methods that everyone can use in order to assess results, compare findings and do statistical analysis, perform meta-analysis, and gain an understanding of what is going on in the field of brain analysis. Thus, the web can be used in medical research to "lower the walls" surrounding such specialized bodies of research as MRI analysis of brain structures, and advance knowledge at a rapid pace. Given secure access and privacy of the information, many projects [4-14] are now trying to convert such personal information into valuable knowledge that becomes part of everyday life in the life of a medical researcher.

In this talk, we summarize some examples of how the web is currently being used to support medical research using human brain data and technologies such as MRI, fMRI and PET. We describe our experiences on building such resources, which requires diverse tools for organizing, publishing, retrieving, employing, analyzing and mining brain imaging multimedia data. We discuss related and interesting issues like accessibility of the data, security, privacy, intellectual copyrights, and so on.

Examples of Human Brain Data Center

The National fMRI Data Center at Dartmouth is an example of how the web is currently being used to support medical research using human brain data and technologies such as MRI, fMRI and PET. Its goal is to create an environment that will benefit the fMRI research community. The Center provides access to a common data set that everyone can use in order to develop and evaluate methods, confirm hypotheses, and perform meta-analyses. The Center also aims to increase the number of cognitive neuroscientists who can examine, consider, analyze and assess the brain imaging data that have already been collected and published. The Center can help speed the progress and the understanding of cognitive processes and the neural substrates that underlie them by (1) providing a publicly accessible repository of peer-reviewed fMRI studies, (2) providing all data necessary to interpret, analyze, and replicate these fMRI studies, (3) provide training for both the academic and professional communities.

The Center will create and host a Web-accessible database that will have data mining capabilities and the means to deliver requested data to the user (via Web, CD, or digital tape). Being Web-accessible implies that researchers from all fields will be able to use the data and hence contribute to the development of fMRI. This is an important point. For the first time, fMRI can easily draw on the knowledge of experts from many disciplines, such as Mathematics (e.g. image processing) and Computer Science (e.g. data mining). Initially, the Center will receive data from those researchers who are publishing peer-reviewed fMRI imaging articles in a journal. The Center is collaborating with a variety of journals; however, the goal is to serve the entire fMRI community with the provision being that all data submissions have been peer-reviewed.

Other such centers to be discussed include The McConnell Brain Imaging Centre (BIC), The Mayo Biomedical Imaging Resource (BIR), the Brain Map Database, The Whole Brain Altas, and so on.

The Web as a Reference, Education and Research Tool

In this part of the talk, we review the different roles of the web in Cognitive Neuroscience: as a reference, education and research tool or resource. The DEVLAB and Dartmouth Brain Imaging Lab are working together to develop such a Human Brain Web Resource (called BRASS - Brain Access Support System).

As a Reference Resource, the BRASS system contains common methods, data sets from structural and functional brain studies, tutorials, glossaries, and related links. What is interesting about this is that a consortium of users is given special access to enrich the resource with materials in the original formats. Then, the BRASS system applies a common evaluation procedure to incoming materials, and multi-indexing techniques to store the information in different locations and in multiple formats (e.g., for use for experimentation or for education). Underlying this component there is an object relational multimedia database to store references for both raw and processed data (segmented images). The user interacts with this component in a standard text-query mode and receives responses that are not simply references, pointers, or links to a location but include annotations and explanations. Every retrieved link or piece of reference information will first be evaluated before it is included into the system based on a standard set of criteria, in order to guarantee reference accountability. The user is supported with tools for searching, browsing and retrieving information from a toolbox.

In addition to the role of the web as a reference, the web serves as an education and training tool in the application we are considering (studying brain morphology). This differs from the reference function in that the focus is on tutorial type of materials. Using the web pool of experts, tutorials for all tools are assembled. The integration of tutorials with the resources is very time consuming and must be done at multiple levels of processing. Each tool is linked with a standard interface that provides information on the type of data, statistical parameters used, size of data, summary of findings, related data sets, etc. Many of the brain imaging techniques, such as fMRI and PET, rely on brain structure resources and their researchers use structure segmentation techniques. Reliable segmentation of a region-of-interest (ROI) in brain MRI images is important for the development of several neurological applications of MRI. Although some semi-automated methods are available, much of this work is still done manually and requires well-trained technicians. Currently, training people to do the tracing reliably involves manually demonstration and supervision, and is not efficient, because existing tracing tools do not combine comprehensive reference, education and experimental training support. To fill this gap, we are developing a new automated training method for the segmentation (e.g., extraction of the contour) of particular brain structures from MRI scans which improves previous manual training methods (manual methods require very well trained technicians to teach novices). Making such an interactive remote training tool to teach brain structure segmentation available to registered users is highly beneficial and cuts cost and time. Using the web, a novice can extract the tool to trace, get feedback from the system that compares the trace with that of experts, and get access to already segmented data.

The web's third role as a research tool is gaining new ground in the study of the human brain [1]. There are many enabling technologies needed to process the data before placing them for web access. The work in data compression [2] is an example that can be applied to the compression of the segmented structural images in the database. Others are tools that can be used to summarize complex 3D structures and their features. We call this "Characterization and Classification of Morphology". An ongoing project in the DEVLAB is the development of new techniques to characterize fMRI (functional Magnetic Resonance) 3D brain activations with the goal of classifying human brain activations by type (size, location, shape, etc.). The result will be a signature that identifies each type of activation. We are experimenting with various techniques for producing vector characterizations. Being able to retrieve such diverse multimedia information, tools for Multimedia Information Retrieval and Computed Synchronization (i.e., using new frameworks for cross modal information retrieval). Finally, using tools for interface and visualization development requires experience with web presentation, Web interface development and multimedia publishing.

Issues

To providing such resources over the web, there are many issues. The first issue is content collecting and maintenance. For such web resources to be useful, they must be dynamically updateable (rather than contain a fixed image and other information set) by allowing special registered users to upload information. Very few such updateable repositories exist today. Providing active participation to users in building the system can be done in a secure way with current technology. However, it implies a set of willing and trustworthy user researchers. Technology must be developed that processes the incoming information so that it is integrated in a consistent manner, transforming to common data coordinates, and with added-value explanations. The raw data need to be processed (indexed, integrated, filtered) and stored in a way that it is searchable, and amenable to database, data warehousing and data mining operations by registered users. Working with registered users, one can collect feedback and evaluation on an ongoing basis.

The second issue is data accountability and evaluation. It is highly important that the web presents correct data and up to date information. For this purpose, continuous checking and accounting of the information is necessary. This requires resources and costs currently not encumbered in most projects. Putting such critical research information on the web can be as dangerous as it can be helpful. For this purpose, several tasks are needed to maintain accountability: (1) collect evaluation reports by the system users regularly and at workshops, and integrate external review boards to evaluate the information; (2) keep a close look at how the resources are being used and even conduct experiments to measure usability, frequency of access, etc, collect demographic data of system use, and collecting such statistics can improve the resource dramatically; (3) conduct experiments to measure system performance in terms of latency of response, recall and relevance of retrieval, network performance; (4) invite user to participate in longitudinal studies that follow career paths and measure system impact in career development.

The third issue is strategies for data accessibility: who gets what. This is related to the cost of maintaining such a resource. One option is free for all users. Another option is for pay: we are developing models for Electronic Commerce to self-finance such web resources. One model could be online consulting. Brain data is valuable information and can be viewed as a commodity by hospitals, insurance companies, and professionals. Online consulting can cover the cost of maintenance.

Other issues are security and privacy. For example, data cannot be maliciously altered. The access transaction should also be secure. Sensitive patient information should be removed from the data and the data is properly cleaned. Intellectual copyright is also an issue. These kinds of web resources obviously have commercial value. However, the copyright law does not protect database. Therefore, it is important to study how to create and protect valuable database of medical brain images and patterns.

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Taming Lakatos' Monster - Computer Virus Epidemics and Internet Security Policy

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Computer Viruses have been a fact of life for computer users for more than a decade. Yet looking at recent events on the Internet, it seems that not only our infrastructure, but our entire information society has become vulnerable to computer crime and hacker attacks. In my talk I take a long look back at the early days of viruses, worms and hacking and link these distant histories with the present to (a) suggest a framework to assess the threat, (b) to analyze why we have not yet mastered this challenge and (c) ask what kind of policies might be necessary to eventually "tame the monster".

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Metadata for Adaptive and Distributed Learning Repositories

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Web-based learning is one of the important applications of the World Wide Web, which makes possible location- and time-independent learning scenarios. Content can also be kept up-to-date, discussions and interactions between instructors and learners can be supported, new materials can easily be distributed to the students. We will discuss in this talk three aspects of web-based learning materials: web-based learning material repositories, metadata annotation for integrating different resources within such repositories and metadata for adapting these resources to different learner goals and knowledge. Web-based learning material repositories have the potential of providing a set of inter-connected learning materials for a specific area, allowing teachers and learners to use various resources as learning and background materials for specific lectures or projects, and which can be extended by teachers and students with various kinds of materials, including student process portfolios and student projects. Integrating materials in such repositories is a difficult task, and indeed basically all existing repositories have only few interconnections between different materials and modules. We will discuss how appropriate metadata annotations can be used to build up such repositories and what kind of metadata might be appropriate. Finally, adaptation based on learner goals and learner knowledge has been a research topic for quite a few years, and several interesting adaptive systems have been developed. Still, these systems are usually standalone systems, and not extendable by external materials. We will discuss how such adaptive web-based systems and course repositories can be built, again based on explicit annotation and indexing with appropriate metadata.

To Mediate Or Not To Mediate- The Role Of The Mediator In The Online Classroom

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Networked computer media have brought significant changes to pedagogical paradigms. Educational environments, such as WebCT, provide a seamless interface for organising online learning and teaching activities, and virtual spaces for computer-mediated communication and collaboration during the learning process. The rate of diffusion of these new technology-enabled environments in education is so rapid that, quite often, tried-and-tested face-to-face pedagogical paradigms are being thrown out without sufficient and considered evaluation of the novel environments. In this paper, a framework for the analysis and evaluation of online seminars is proposed. The proposed framework is based on a quantitative analysis of participation and a qualitative content analysis.

***CV:** Fay Sudweeks is a Senior Lecturer in Information Systems at Murdoch University, Perth, Australia. She has a BA (psychology and sociology) and an MCogSc from the University of New South Wales, and is completing her PhD in Information Technology. She has given lectures in diverse countries such as Israel, Sweden, Germany, Bulgaria, Russia and South Africa. She has published five edited books, including Network and Netplay: Virtual Groups on the Internet (MIT Press, 1998) and Doing Business on the Internet: Opportunities and Pitfalls (Springer, 1999). Her research interests are social, cultural and economic aspects of computer-mediated communication and computer-supported collaborative work.*

Four Dimensions of Knowledge Management -

Organizational Memory, Knowledge Retrieval, Knowledge Visualization and Knowledge Transfer

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Abstract: Information technology is used pervasively in organizations and thus qualifies as a natural medium for supporting the flow of knowledge within an organization. For an efficient knowledge management the application of information technology should take an integrated view on four dimensions: An organizational memory is the key to maximizing the return on intellectual assets of an organization. Knowledge at your finger-tips is certainly one of the most attractive visions knowledge management can offer to its users. Knowledge retrieval helps make this vision become reality. Knowledge visualization supplements knowledge retrieval in that it offers users sophisticated techniques to visualize complex structures, to contextualize knowledge and to see invisible patterns in organizational memories. Today organizations are also required to continuously extend the knowledge of their employees to meet requirements in new global markets, economies and societies. It is evident that knowledge transfer, i.e. the integration of lifelong education and training in our private and working life, will play a central role in this context.

1. Introduction

Many future-oriented thinking companies have recognized that the management of intellectual capital and knowledge will be vital for a sustained competitiveness in a new business landscape which is often referred to as the New Economy. In the New Economy the value of an enterprise is much more based on intellectual assets rather than on material assets. For example, General Motors (GM) is a traditional industrial company with many material assets, such as land, buildings, equipment etc., with US $168 billion in sales in 1996. The market value of GM was US $50 billion in 1997, while the market value of Microsoft, a company with many intellectual assets, such as copyright on Windows operating systems, was US $120 billion. The difference is quiet impressive if one takes into account that Microsoft had "only" US $9 billion in sales in 1996. This example between a pioneering company in the Old Economy and a pioneering company in the New Economy shows that the successful management of invisible assets will be playing an increasingly important role to improve the performance and, thus, to increase the value of almost any type of organization.

Often the terms intellectual capital management and knowledge management are used as synonyms, even though a fundamental difference exists. According to Wiig [Wiig 1997] intellectual capital management focuses on building and governing intellectual assets from a strategic perspective. This includes to renew and maximize the human capital (e.g., competence of employees), customer capital (e.g., value of relationships with customers), or process capital (e.g., organizational structure). In contrast, knowledge management places the emphasis on an operative perspective. It is concerned with creating, capturing, extending and transferring knowledge within an organization. The focus of this paper is primarily on management of knowledge rather than intellectual capital. For a study about measures for intellectual capital the interested reader is referred to [Bontis et al. 1999].

To implement knowledge management in an organization, different aspects from different disciplines have to be taken into account. Organizational aspects are required to define which knowledge should be captured and the way it is captured. Often a new knowledge-friendly culture has to be implemented within an organization. Such a culture is necessary to support knowledge sharing and to overcome the employees' fear that sharing of knowledge means loosing power. Additionally, information technologies (IT) have to be introduced widely as the enabling technology for knowledge management. A general lesson learned is that using IT for knowledge management often meets resistance. Therefore, organizational and cultural change have to be taken place first.

The introduction of IT afterwards will then be considered a help rather than a burden.

The purpose of this paper is to present an integrated four-dimensional view on knowledge management from an IT perspective. This view evolved in the course of extensive discussions with the KNOW-Center's partner companies which are planning to develop or introduce a knowledge management system or components of a such a system. The remainder of the paper is structured as follows. Section 2 gives an overview of the knowledge management approach pursued by the KNOW-Center. Section 3 focuses on organizational memories, Section 4 on knowledge retrieval, Section 5 on knowledge visualization, and Section 6 on knowledge transfer. The paper closes with a brief conclusion.

2. IT-based Knowledge Management - And the role of humans

Often IT-based knowledge management places too much emphasis on the IT-component and, thus, tends to neglect the role of humans in knowledge management processes. Our point of view is that every IT-based knowledge management system should serve humans and their needs rather than humans serving the system. This leads to our cycle of IT-based knowledge management:

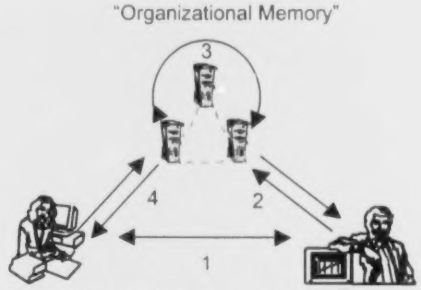

Figure 1: IT-based knowledge management cycle

Arrow ❶ in figure 1 shows that one of the most important ways to capture, disseminate and share knowledge is human-to-human interaction. Three ways exist to derive computerized knowledge from human knowledge (❷): a) users explicitly input knowledge, b) users implicitly create computerized knowledge as by-product of processes they are carrying out anyway, and c) users input implicit knowledge without being aware of it. Systemic actions, i.e. actions which are triggered by the system, are needed to make this implicit knowledge explicit to the system and to create computerized knowledge (❸). Examples for systemic actions are known from artificial intelligence where inference mechanisms derive new knowledge from already existing knowledge. Two ways exist how computerized knowledge flows back to humans to create human knowledge (❹): a) by explicit queries for individual pieces of knowledge and b) by systemic actions, which become active according to user behavior patterns or user profiles. Often such actions are referred to as push-technologies, i.e. the system pushes knowledge pieces to the user rather than the user becomes active and pulls the knowledge from the system.

This model rises the question of how these knowledge flows can be supported best with IT-based components. The notion of the KNOW-Center is to promote an integrated view on knowledge management by taking four dimensions into account: An organizational memory is imperative for storing and maintaining the knowledge available. Knowledge retrieval supports primarily users in retrieving knowledge in the system. In addition, knowledge retrieval holds a great potential for analyzing the needs of users and for assessing the quality and completeness of an organizational memory. Knowledge retrieval can be supported with knowledge visualization concepts which help make visible the otherwise invisible. Once knowledge is retrieved it has to be transferred from the system to the user (and vice versa). The main challenge for the knowledge transfer is to avoid that transfer processes change the meaning of the knowledge or put the knowledge in a wrong context.

3. Organizational Memory - An analogy to the human memory

In literature an organizational memory is often explained as the systematically archived collection of all explicit knowledge available in an organization. Considered from this perspective, an organizational memory

databases, information systems etc. It is imperative for an organizational memory to hide this complexity to the users. This is why portal solutions (e.g., enterprise information portals), often referred to as "single point of

apply Internet-technologies for a very clever integration of heterogeneous platforms. Or they provide very user-friendly interfaces to facilitate search for and retrieval of knowledge pieces. For example, in digital libraries,

search and retrieve data than to add new data to a web server. Authoring functionality was and often still is a privilege for some authorized users. The strict separation between authors and readers may be appropriate for

purposes. What can the value of an organizational memory be if knowledge sharing between the users is not supported? What can the value of an organizational memory be if users cannot add their own knowledge? What

needs? Instead of a "single point of knowledge access" an organizational memory should be understood as a "single point of knowledge sharing". This leads to a slightly different notion of an organizational memory.

features supporting knowledge sharing, knowledge authoring and knowledge customizing. To continue the analogy to nature, knowledge sharing corresponds to the neuronal network of a human memory which connects

organizational memory yellow pages and communities of practices can bring together people with special knowledge. An authoring component is inherent in every human memory as nobody can consciously "switch

people memorize important knowledge much better than useless knowledge. Similar to this, knowledge authoring allows everybody to extend an organizational memory. But the quality assurance must be integrated

customizing has its analogy in the phenomenon of the human memory to provide a person exactly with knowledge which is relevant to best perform a specific task in a specific context at a specific point in time.

(timely and trustworthy).

Finally, the term "organizational memory" implies that such a memory covers primarily the needs of an
personalizable knowledge management at an individual level is not taken into
account. The main reason is that knowledge management at the organizational level has different objectives
personalizable knowledge management. The KNOW-
Center takes the view that the highest user acceptance can only be reached if personal knowledge management

4.

Knowledge at your finger-tips is certainly one of the most attractive visions IT-based knowledge management can offer to its users. Knowledge retrieval faces numerous challenges in helping users find what

hypertext, and artificial intelligence can be applied to knowledge retrieval. For example, the separation between the two different retrieval paradigms searching and browsing also applies to knowledge retrieval: conceptual

where?, who? and what? [Veltman 1997]; and finally
give a unique semantic Fensel et al. 1998]. Implicitly, typical search strategies, search forms and query languages for information retrieval are based upon the assumption that users are familiar with

users want to find information about document description languages which separate between a document's layout, structure and content, they formulate a query such as "Find all documents dealing with XML or metadata search returns those documents which are cataloged with XML and SGML as thematic metadata. Such a query implies that users have already heard about XML and SGML. Even though most of the above

retrieval. Knowledge retrieval should support users in describing their "problem" with the knowledge they have about the problem and without being required to be familiar with a specific terminology. To take the above

they are interested in "possibilities to separate a document's layout, structure and content". Such descriptive approaches for knowledge retrieval require much more sophisticated search strategies and new approaches to

In the near future digital video/audio will emerge as an important representation form for knowledge. Organizational memories will include video and audio archives with recorded speeches, multimedia learning

analog audio and video material are waiting for getting digitized and supplemented with appropriate metadata. To this end new methods for knowledge retrieval which go beyond today's annotation concepts are required.

complex languages for video annotation (e.g., Media Streams from MIT Media Lab). Annotation is a broad concept which ranges from the registry of physical characteristics (e.g., color or special effect) to content

and efficient search for digital audios/videos. Different levels of abstraction have to be developed. A low level

and for audios mood, tempo, tempo changes etc. The highest level of abstraction would give semantic

abstraction is related to the way the metadata can be extracted. Many low-level features can be extracted in fully automatic ways, whereas high level features will need much more human interaction. From the perspective of

knowledge pieces in an organizational memory. The most intuitive form are descriptive queries such as "Find the video with a chirping bird in a tree".

of how knowledge retrieval can be used to enrich an organizational memory. This idea originates from the observation that every query contains a lot of knowledge about how users work with an organizational memory.

identify missing knowledge. Such an analysis can indicate that something is wrong with how the knowledge is

organization. Such an identification is of great importance for an organization: From the perspective of

organization's strategy to build up future intellectual assets. From the perspective of knowledge management, the organizational memory can be improved with the provision of the respective knowledge. In this context,

management.

5. Knowledge Visualization - Making visible the invisible

Visualization of knowledge pieces stored in organizational memories can help
can significantly make visible the otherwise invisible [Tochtermann et al. 2000b].
visualizations with meaningful axes are an effective visualization strategy because thousands of knowledge pieces and the relationships between them can be shown at once. Generalized hierarchies as a special form of

the complexity by organizing related knowledge into comprehensible structures. Such hierarchies allow multiple classifications of the same object (solving the old "library dilemma": where to put a book on

knowledge management system since it allows to have one copy of a document but many pointers to it. The user does not see the pointers, but has the feeling that many copies exist. Carried further this means that an organizational memory can be accessed using arbitrary many paths. In addition, innovative three-dimensional structure visualization mechanisms, such as "information pyramids" or "NewsMaps" allow users to have different views on and perspectives of the content of an organizational memory. For example, the concept of NewsMap is an promising visualization approach for contextualizing knowledge [NewsMap 2000]. NewsMaps look like topographical maps of mountains and valleys. Documents with similar content are placed closer together, and peaks appear where there is a concentration of closely related documents. The valleys between peaks are interesting for two reasons: First, they contain fewer documents and more unique content. Second, they make visible the otherwise invisible as they indicate that the organizational memory is lacking knowledge in certain areas.

Conceptual navigation can be improved by sophisticated visualization components which interactively guide knowledge workers through an organizational memory. Even though a number of pioneers are assuming that two-dimensional navigation will soon be discarded as a thing of the past and everyone will use three-dimensional knowledge spaces for navigation, we want to focus on both two-dimensional and three-dimensional visualization concepts. A reason for this decision is that two-dimensional visualizations require less complex user interfaces and are thus easier to handle. Another reason is that many tests have shown that three-dimensional visualization is cute, but not necessarily helpful. We want to investigate whether three-dimensional navigation is indeed as helpful as some people seem to think. The usual argument is that nature is three-dimensional, hence it is clear that navigation should also be three-dimensional. We believe that this kind of argument is not always valid. In nature birds fly by flapping their wings, but airplanes don't. In nature, animals walk but fastest transportation is on wheels. Just because something in good in nature does not mean that it is the best technical solution.

6. Knowledge Transfer - Bringing the right knowledge to the right people

In the emerging information (knowledge) society, the dominating strategy for organizations to become more profitable and competitive is to increase the innovation speed hoping that better technical solutions will solve many of the current problems. However, an increased innovation speed also leads to problems because many employees cannot keep pace and thus can no longer be sufficiently involved in the economic process. To overcome this hurdle support for education and life-long learning is imperative for organizations if they want to stay successful and competitive in the long run. What is required are means for organizations to build up an organizational memory and to utilize this knowledge to its maximum potential with support of methodologies and tools specifically designed for life-long learning, long-distance education etc. Educational programs require methodologies which support the mapping from computerized knowledge back onto human knowledge. In addition, it is crucial that the process of internalization of knowledge (e.g., understanding the information, putting it into context with existing knowledge) is well supported. Against this background knowledge transfer covers a broad spectrum including support for employees to exchange knowledge, feedback mechanisms, evaluation and certification mechanisms, support to design courseware, and learning strategies.

Knowledge transfer between people can take place outside but with support of a knowledge management system. Often finding people is more valuable than finding knowledge. That is, instead of making available the knowledge a person has in a specific subject domain, yellow pages can be used to make available the information about which person is an expert in which domain.

Traditionally, questionnaires are used to get feedback from users about the quality of a course or the value of a knowledge piece. However, questionnaires are often considered as an additional burden and are filled in with very little care only. Therefore one aim is to find alternatives for unobtrusive feedback, i.e. without molesting users. An idea for future research is to distribute the questions as "questionnaire-lets" among the courseware instead of asking them all at once in a single questionnaire. For example, questionnaire-lets can be combined with navigational buttons in that users have two buttons to continue their navigation: one of those could say "I like the way how the material was presented, please continue" while the other button could say "I did not like the way how the material was presented, please continue". A problem users may encounter with this concept is that they get distracted when they have to decide if they liked the presentation of the courseware or not. Due to this distraction users might even forget what they have just learned. Psychologists explain this phenomenon with the three existing types of memories (i.e., short-term, medium-term and long-term memory). The migration of the knowledge from the short-term memory to the medium-term memory can be disturbed or even

The design of courseware is coined by two trends: first, the Internet emerges as the primary medium for courseware distribution and use; second, the use of multimedia is almost a must to increase the degree of
"tunnel
syndrome" which is an obstacle well-known from Computer Based Training (CBT). The tunnel syndrome is the

to solve this problem is to provide multiple ways each of which leading to the same target. At least four different possibilities exist: 1) A knowledge transfer system can offer background libraries a user can visit

content; 3) A user can ask questions to the system which will be answered from an expert (or directly from the documents themselves), 4) Communication features allow users to contact others to discuss questions [
1998].

Multimedia standards such as SMIL or MPEG-4 are well suited for designing Internet-compliant

scene to jump to another scene or to follow another path of the courseware. Today, however, the design of such interactive courseware requires authors to program the interaction using some kind of scripting language (e.g.,

author which will be replaced in the near future by more sophisticated authoring tools.

Finally, t
exist. This can be explained best by taking an analogy from books and movies: Often people are so enthusiastic about a book they have read that they also want to watch a movie about the story of the book. Often, however,

and the movie are at different levels of abstraction. While the movie is very concrete (e.g., the main character is middle-aged, small and almost bold) the book is at a higher level and thus allows the readers to have their own

hair). Similar to this new document types for multimedia documents should allow to compose scenes in a movie using abstract symbols instead of concrete objects. These abstract scenes can then be instantiated to produce

must look like to efficiently retrieve abstract movies or parts thereof [Lennon et al. 1994].

Conclusion

dimensions are related to each other. The development of appropriate tools for each dimension and their integration are on the KNOW-Center's research agenda for the next four years. First results are already
Tochtermann et al. 2000a] a prototype
system is described which combines organizational with personal knowledge management. In [
al. 2000b] concepts for knowledge visualization in the context of knowledge retrieval are presented.

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Social Construction of the Internet Society

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When Web access first started to get spread, it by and large disappointed its users, or at least. Early magazine and newspaper reviews often complained about a lack of 'content', and indeed very few sites offered any substantial information that was of interest outside a quite small community of researchers. In the year of 2000, the same disappointment taints the WAP phones. We may ask ourselves why the WWW still succeeded in attracting more and more users simultaneously with more and more commercial sites? Today, nobody would complain about lack of content on the web – rather, the problem is now the opposite – the web contains too much information to be searchable in any useful manner.

Why did the WWW manage to grow out of its infant crisis? The answer is that the web already from the beginning was much more than a pure information media. Even though it did not offer much of a dialogue, it was still was a media for social interaction. The web was a place where one would find information with a real person behind it. If you wanted to travel to Athens, you could look up Peter's page about his last year's trip to Athens. And even if you did not know Peter, you would feel that his personal, devoted, and non-profit, description of Athens gave a much better picture of the place than any tourist brochure would.

Commercial sites offering 'real' information and services soon begun to dominate the scene. But even so, the social nature of the web pertains and has become much richer. Today, many web users visit almost exclusively sites that offer social interaction: discussion groups, chats, multi-user game environments. We may visit the 'reloaders' that write their diary on the net, or the families that offer snapshots from their home environment, or daycare centers to watch lunch being served.

The web of today has a double nature. There is a clear split between the sites that offer social interaction as their main attraction, and the sites where social interaction is not an issue at all, or at best seen as a secondary functionality. This is at odds with real life. Most of us do almost nothing entirely on our own: we use others to help us find information, to share our work tasks with, to share our household chores, and to think together with. The web was never a pure information media, and it is even less so today, as it is developing into a carrier for most Internet-based services. I believe that in this process, we should take great care to intertwine social interactions with all types of services, not as a side functionality or a way of attracting users, but as a fundamental aspect of human work and leisure practices.

In my talk, I will describe four ways in which web services, and Internet services in general, can be based on social interaction. These are synthetic characters, social information navigation, the public discussion, and finally, the collective creation of web services. The ordering reflect a gradual move from systems where service suppliers are in complete control over service content, via systems where users provide navigational information and content, to systems where users create their services, and there no longer is any clear difference between users and service suppliers. In my presentation, I will present several example systems developed within my research group at the Swedish Institute of Computer Science, but I will also bring up examples from other research groups as well as commercial systems.

Synthetic Characters

One way to use our need of, and joy in, social interaction is to equip web sites and web services with synthetic characters that users can interact with. Characters can play several roles in a web service: most often, they are seen as help agents, that supply help or search facilities in semi-natural language. At the Swedish Institute of Computer Science, we have developed and evaluated the Agneta and Frida characters, who supply support in web navigation in a rather roundabout way. Agneta and Frida are not helpful: they are humorous and sarcastic, as they sit on your screen watching your web browsing. They help in web browsing by giving additional clues to web pages: it is very easy to remember a page when you heard a nasty joke about it. Agneta and Frida is only one example of how synthetic characters can be used to provide a social stance to an otherwise completely traditional information-based web site.

Social Information Navigation

Social information navigation takes one small step towards giving some control to the user community of web services. In social information navigation, the presentation of the content of a service depends on how it has been used by other users. The research field is based upon the simple observation that in real life, we very seldom seek information primarily by searching for it in any objective manner. Rather, we gather information primarily through interacting with other people. What do you do when your dog coughs? Maybe you call to your good friend that owns the same kind of dog. Or if you actually did look it up in a book, you will most likely call your friend anyway, and discuss what you read with her. Social interaction aids you in your information gathering in several ways. Firstly, it saves you the trouble of finding the right book or searching the right entry in the book. Secondly, you know you can trust your friend's advice. Finally, since she knows you and your dog, she will be able to ask the right follow-up questions to avoid misunderstandings, and to give an answer that is highly personalised to your mutual understanding of the dog.

This form of social navigation can be called direct social navigation: people contact other people directly and the sought information is found at after some discussion. Social navigation also occurs in an indirect form: following in the footsteps of other users. In real life, we use indirect social navigation a lot: we follow a mass of people leaving the plane towards the baggage claim, we use a well-trodden train in the woods, we visit a restaurant that is full of people. Recommender systems, filtering systems that are based on the activities of others, constitute a type of indirect social navigation. Other examples are systems that visualise common user paths through web sites, or recent activities in a web site.

I will present the EFOL system that integrates direct and indirect social navigation in a singular application. EFOL is an on-line food store in which users shop by selecting recipes to cook rather than individual ingredients. In EFOL, we make the activities of users visible by showing how many people currently are using the system and which recipe collections they are using; we allow users to chat with each other to give tips about nice recipes. Finally, user selections of recipes are used to sort the recipes according to popularity. The EFOL system is a good example of how the task of finding a suitable piece of information can be made into much more than a pure information retrieval task. Firstly, social interaction is fun and makes it more pleasant to use the system. Secondly, social interaction changes what information you find, as what is deemed relevant for you depends on what other people liked before you. Finally, social interaction will affect what information you like, as the implicit or explicit advice of your fellow users will make you change your preferences!

The Public Debate

So far, we have assumed that the information itself is stable, and that user participation only affects how we navigate it. However, the collaborative creation of information has been an integral part of the Internet from the start: in readnews groups, in chat sites and today in different types of expert advice sites. An important quality of these forums is that the quality of a piece of information is determined collectively, by supporting or falsifying comments, which sometimes lead to heated debates. The collective formulation of a 'truth' that occurs in these forums mirrors the ideas of truth through public discussion, that has its roots in the 18th century ideas of the ideal democracy.

However, the new forums can hardly be seen as democracy institutions: they attract small communities that soon develop a highly specialised agenda and often a language of their own. In one of our research projects, we develop models for news services that fall in between these closed community discussion groups, and the commercial production of news services for the mass public. The basis of this media can be the ordinary web news channels, or invited columnists. To come closer to the early democratic ideals, the media should ideally contain many such sources, to avoid a close association to one particular news provider. But in addition to the news articles provided this way, or discussions started by columnists, any reader can choose to 'go on stage' – to write a news story, to contribute to a discussion, or to comment an assertion that they believe false. We use design ideas from social navigation to encourage participation and guide people to the most active discussions.

Social Construction of Web Services

Is it possible to go further than this? So far, we have showed how social interaction can be used in the design of web sites, how it can be used to guide our navigation through information, and how the content itself can be formed in a social and democratic activity. But in the perspective of the rapidly growing mass of bank services, travel agencies, and other commercial web services, we have only scratched the surface. Can we arrive at a public and democratic construction of the entire landscape of web services?

This is a question that we only have begun to seek an answer to, but I believe that the answer is 'yes'. We should remember that in its infant stages, the private construction of web services (home pages) was one of the largest attractions of the web. Today, the creation of social and mobile web services is a much more complicated task, requiring high skills in programming and access to vast amounts of computer resources to set up a service. At SICS, we have developed an alternative architecture for Internet services that strive to overcome these problems, the sView architecture. The vision for this architecture is that each and every person should own a private 'service briefcase', which carries much of the service logic and some of the data content of the web services that the person regularly uses. An important point is that the briefcase is mobile, so that it can be downloaded to any computer or communicator that the user uses. It can also accessed remotedly, and at a server anywhere in the network.

How does this service briefcase help in the social construction of web services? Well firstly, the briefcase can carry support for many of the basic functionalities that mobile services need to perform, so that service development is simplified. In particular, the sView system takes care of all moves and synchronizations of briefcases. Furthermore, the sView system already supports user interaction over several media, as well as search for available services using Jini technology. It can easily be made to provide secure communication between local service logic and a server. In future versions, we will also aim to include tools for graphical development of interfaces and local service logic. But more importantly, users can themselves control how services are allowed to collaborate. Since services save some of their logic locally, users can be involved in connecting them to each other, for example, getting a bank service to provide payment for goods ordered from a particular on-line store. Users with programming skills may be able to do such connections by inspecting the logical interfaces of services. But we will also use techniques from programming by demonstration to allow users to simply show services how they should collaborate. Finally, we will aim to equip our sView system with back-end services that save examples of such connections and 'mini-services' for reuse by other users. In these directories of service connections, we can use social navigation to provide users with information about which connections are most useful and which should not be trusted. This way, both the actual services available over the net, as well as the directories over services, can be socially constructed.

With this as my closing example of user participation in the construction of web services, I hope to have shown that the social construction of the web is not a closed chapter of its history. Indeed, my hope is that in the future, we will have even more powerful tools at our hands to together shape the Information Society – all of us, hands on, not by market demand, but by active participation in a global, universally accessible, and democratic society.

KEYNOTE

Weaving Information into Our Lives

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Information has long been understood as a separate world, whether the parallel realm of Platonic ideals or the sovereign nation of cyberspace. Computer technology itself has reinforced this understanding of information by compelling us to interact with it while sitting still in front of a glass screen. But this is changing. Computing is rapidly becoming portable, wearable, and generally woven into the activities, relationships, and institutions that organize our lives. How can we understand this complicated new "interface", and how can we design for it? I will present several concepts that may help. In particular, I will argue that this new realm of information systems design cannot be dissociated with the much larger process of redesigning, or at least evolving, the most basic workings of society for a networked world.

***CV:** Philip E. Agre is an associate professor of information studies at UCLA.He received his PhD in computer science from MIT in 1989, having conducted dissertation research in the Artificial Intelligence Laboratory on computational models of improvised activities. Before arriving at UCLA he taught at the University of Sussex and UC San Diego, and has been a visiting professor at the University of Chicago and the University of Paris. He is the author of "Computation and Human Experience" (Cambridge University Press, 1997), and the coeditor of "Technology and Privacy: The New Landscape" (with Marc Rotenberg, MIT Press, 1997), "Reinventing Technology, Rediscovering Community: Critical Studies in Computing as a Social Practice" (with Douglas Schuler, Ablex, 1997), and "Computational Theories of Interaction and Agency" (with Stanley J. Rosenschein, MIT Press, 1996). His current research concerns the role of emerging information technologies in institutional change; applications include privacy policy and the networked university. He edits an Internet mailing list called the Red Rock Eater News Service that distributes useful information on the social and political aspects of networking and computing to 5000 people in 60 countries.*

The Co-evolution of Digital Libraries and the WWW

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In 1993, Tim Berners-Lee and I both spoke on a panel, he on WWW and me on digital libraries. Nobody present seemed really interested in either topic. Yet these two areas of activity have evolved together over the last decade, leading to many global changes, expanding along with related technologies. This talk traces the recent evolution of digital libraries and the many interactions between practices in the two fields. We build upon the 5S framework - of streams, structures, spaces, scenarios, and societies - to show the potentials and limitations of these areas. We emphasize how all this relates to education, building upon our work with the Networked Digital Library of Theses and Dissertations and Computer Science Teaching Center.

***CV:** Edward A. Fox is a Professor of Computer Science at Virginia Tech, which he joined in 1983, after completing MS and PhD in Computer Science at Cornell University (following work in industry and BS from MIT in Electrical Engineering). He has worked on information storage and retrieval, electronic publishing, multimedia information systems, educational technology, computational linguistics, and other fields. In the area of digital libraries, Fox has led efforts on 4 books (Sourcebook on Digital Libraries, Dec. 1993; Proceedings for DL'96 and DL'99, and Sourcebook on Electronic Theses and Dissertations, in preparation). In this area, he has co-authored 16 refereed conference papers plus 22 journal/magazine articles, serving as lead editor for special sections on digital libraries in Communications of the ACM for April 1995 and 1998 plus May 2001 as well as three other journals. He has written two overview book chapters and is working on others (including for ARIST). In fall 1997 and 2000 he prepared a graduate and an undergraduate course on digital libraries. Fox has given hundreds of talks on digital libraries, including tutorials completed or planned for Canada, Costa Rica, Croatia, Singapore, South Africa, South Korea, and the USA. Fox directs the Networked Digital Library of Theses and Dissertations, manages the digital library for both the Computer Science Teaching Center and Curriculum Resources in Interactive Multimedia, and directs the Digital Library Research Laboratory as well as the Internet Technology Innovation Center at Virginia Tech.*

Incubating New Zealand: The Passing of Traditional Society in the South Pacific (Multimedia with sound, Maori music, moving images)

Dr. Howard H. Frederick, Professor of Innovation & Entrepreneurship
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Knowledge workers and educators are discovering New Zealand as a lifestyle choice, not to mention an investment and business destination. Known for its extreme sport and innovative culture, New Zealand is as large as the world's 74th largest city, Miami, Florida, but it has a landmass as big as Colorado. What does country vastly rich in natural resources and beauty do in the knowledge economy? How do you incubate an entire nation? What are the "speedbumps on the Kiwi information superhighway"? How to include Maori and Pacific Islanders in an inclusive information society?

CV: *A specialist in technology and national economic development, Frederick's experience includes extensive experience in Latin America, and Central and Eastern Europe. A Californian and Stanford graduate, Frederick emigrated to New Zealand to enjoy the fruits of the knowledge economy.*

Howard H. Frederick is recognised as a authority in the field of global communications, economic development and new technologies. He is the author of New Zealand's Knowledge Economy report (1999) (www.knowledge.gen.nz). One of New Zealand's leading advocates for the knowledge economy path to development, Frederick is New Zealand's only Professor of Innovation & Entrepreneurship, based at the UNITEC Faculty of Business in Auckland. Before moving to New Zealand, Frederick taught at such universities as Ohio University, University of California, American University, and Emerson College. From Emerson College he was tapped by the German government to head the Saxony Telematics Development Corporation in eastern Germany until moving to New Zealand. Frederick is Director of the New Zealand Centre for Innovation & Entrepreneurship, a New Zealand technology incubator focused on mobile, m-commerce, multimedia. He serves as well as a councillor on the Internet Society of New Zealand (www.isocnz.org.nz)

The Business Of Electronic Government

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With ubiquitous communication WWW, W@P, etc. we are facing that government is slowly undergoing the same procedure as commerce. The avenue from offering information and attracting awareness to actively enrolling procedures over the electronic media is open. Strategic plans like the eEurope initiative and legal frameworks are developing in various environments and fostering WWW applications.

Still the question is and remains whether electronic media are suitable in a large scale, high value deployment and how risk can be kept to limits. So far the open and large scale use of the WWW has been for entertainment, training, adds, eCommerce etc. All such applications are mainly in a low value range which also makes it hard for an attacker to design an attack that returns large profit.

Electronic government is differing greatly from electronic commerce. This is the case in many ways. Many electronic government transaction are unilateral and unsolicited. Most such transactions are without prior contractual provisions and, as we might see large deployment, such transactions will de facto no more be on a voluntary basis. In addition to these facts electronic government sets a very high demand on durability of documents and provability as the business cases are very large and interrelated in general. Finally the legal demands are quite different to those in the commercial area.

Systems for electronic government have to cope with data protection with potential viruses an other malicious effects endangering such systems.

The main tool enabling electronic government is the electronic signature as a legally recognized replacement for the manual signature. This is also changing the assumptions. So far we only had to manage quite short chains of transactions like an order and a delivery. Introducing electronic signature in a file for electronic government will demand such chains to be very long not to lose capability of proving. Basically this is due to the fact that there is no way to handle the transition from one media to a different one in a satisfactory and consistent way. But it is not only bits versus paper with electronic signature we can even think of duly signed audio and video gaining document status.

Even if many side effects will put a high demand on the open systems enabling electronic government, there is an enormous challenge to go this avenue.

The challenge is on both sides. Administration is observing a high potential of cutting public expenses and the user will benefit from a swift operation driven by proper workflow enabling tracking of his applications. We have to be careful to design secure enough systems that meet the demands and minimize the risk.

One of the major risks in this context is definitely to separate the citizens even more into those knowledgeable and the less enabled.

***CV:** Reinhard Posch was born 16th April 1951 in Graz, Austria. From 1957 to 1969 he went to primary and grammar school in Graz. Then he studied at Graz University of Technology mathematics with special emphasis on data processing and got his masters degree (Dipl.-Ing.) in 1973. He got his Ph.D. also at this University in Informatics and Telecommunication. From 1971 to 1979 he worked for the Graz Reasearch Ceter in the fields program design for road construction, operating systems and terminal handling. From 1974 to 1984 Reinhard Posch was assistant professor at Graz University of Technology. During a break in this period in 1979 he worked at Sperry Univac (Roseville, MN, USA). There the main topic he worked on was lower layer design for local area networks. In 1984 he got approved as Lecturer ("Habilitation") for*

"Applied Information Processing and Information Technology". Since 1984 he is full Professor. He is head of the Institute of Applied Information Processing and Communications Technology at the Graz University of Technology since 1986.

Reinhard Posch is married (Dipl.-Ing. Ursula Posch) since 1976. He is father of three children (Irene 1983, Andreas 1985, Angela 1988).

At present Reinhard Posch is member of the Oenorm (Austrian standards body) Cryptography and Machine readable cards group. He is also member of many professional societies: IEEE, ACM, OCG (member of the board of the Austrian Computer Society), OGI (Oesterreichische Gesellschaft für Informatik), ACONET, OeMG (Oesterreichische Mathematische Gesellschaft) GME (Microelectronic society) etc.

He is the Austrian representative in IFIP TC6 (Communication) as well as IFIP TC11 (Computer Security). He got elected vice chairman of TC11 for the period 1995-1998.

Reinhard Posch was also the coordinator for the Austrian EUROCHIP (ESPRIT II) project and is at present coordinator if the OCG IT-Security group.

Besides this Reinhard Posch is member of the Working group on Security of payment systems with chipcards of the Austrian National Bank. He has been working as a consultant for the Austrian Lottery and the Mobilkom Austria. He is also engaged as an expert witness by Austrian courts in the field of IT-Security.

In the field of security Reinhard Posch is also a consultant of the IPTS Institute for Prospective Technological Studies, Joint Research Centre (European Commission) Seville. He worked with the OECD group of experts on cryptography in preparing the OECD guidelines for cryptographic policies. At the national level he is consulting the Federal Chancellary and the Ministery for Interior Affairs on matters of security and cryptography.

Reinhard Posch was member of the Austrian delegation consulting on the EU-directive on electronic signatures.

Since May 1999 Reinhard Posch is also scientific director of the Austrian Information Security Center (A-SIT).

PANEL PAPERS

Building a Dot-Com Brand from Scratch

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Abstract: This panel describes how to develop a dot-com brand from scratch by integrating its Web, advertising and public relations strategies. Panel audience will hear from representatives involved each perspective and describe how each element – the Web site, public relations activities and advertising – can be leveraged against each other to extend the brand. Personalization is stressed in all three areas.

On any given day, consumers are barraged by hundreds of messages. There are more television news, entertainment and information channels than ever; radio stations are constantly airing news, music and other information, and advertising is everywhere. As a result, many consumers feel overwhelmed and many messages are ignored and lost in the clutter. Creating a great brand and communicating it properly is key for standing out in the noise. In order to build a great brand, your communications, especially your advertising messages, must be noticed, believed and remembered.

It used to take a long time to build a brand. Some of the world's most recognizable brands, such as Coca-Cola, have taken years to develop. In today's fast-paced world; however, brands can be developed quickly by companies getting noticed, believed and remembered, which is accomplished by making your advertising unexpected, likeable and consistent.

Unexpected can mean a variety of things. It's developing ads in a way that makes people take notice. Cellmania.com's recent television commercials utilize the unexpected by featuring the "Tonight Show" regulars, Lindsay and Jodi. These girls are the everyday-person types, but they are recognizable to millions of viewers across the country. You would not expect them to be in an online wireless retailer commercial. The ad concept and the humorous roles they play in the commercials are attention grabbing.

People also need to like what you are saying. If they don't like it, they won't agree with it, and you will ultimately not be able to convince them to do what you want. Creating likable messages means understanding the customer and his or her wants and needs. The airline industry has been demonstrating this principle lately by communicating to customers that they are listening and working to rectify customer dissatisfaction. For example, American Airlines recently put its "Something Special in the Air" campaign on vacation in favor of a "More Room in Coach" message, addressing an immediate concern of its customers. Delta Airlines has done the same thing by advertising its e-ticketing conveniences. In order to have a likable message, you must demonstrate you understand your customer.

Consistency is key and absolutely necessary in building a brand. Key messages should be communicated over and over again in a positive tone, and a consistent look needs to be established for all your communication. This includes television, Web advertising, print advertising, letterhead, invoices, outdoor advertising, public relations and any other means you use to communicate to your audiences. Radio advertising must reflect your TV and print ads, with all exuding a consistent feel. All messages must be unique, targeted, clear and likable, time after time.

In addition to formal advertising efforts, remember to use your ad buys to leverage other opportunities that can support your brand. If you have a radio buy, negotiate a separate on-air promotion that can help you get more marketing activity for your money. The promotion can be a reflection of your company's policies, products or ideals and can directly tie-in to your advertising. Promotions should never be considered separate from your branding efforts.

When developing your brand, keep in mind there are new marketing opportunities being offered all the time. E-mail commercials, complete with video and sound, are common now. E-billboards are becoming more exciting and sophisticated than ever, and the world of wireless is likely to become another advertising venue as more and more people begin using Web-enabled phones. Many of these tactics are highly targeted and if they reach a good portion of your audience, they should be made an integral part of your branding strategy.

Brand advertising should never exist in a vacuum but should work in tandem with your other communications. Make sure your brand advertising is clear and universal enough to allow for integrated marketing applications. Public relations opportunities can be leveraged from advertising, promotions can result in media coverage, and your Web site must reflect what you are communicating. Having all your marketing disciplines work together is the fastest, most effective way to build a long-lasting, positive brand.

Building a Dot-Com Brand from Scratch

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Public relations is critical in the branding process, especially in the e-commerce world. It is not a matter of simply placing news stories and staging launch events, but it involves identifying your key publics and establishing relationships with these audiences, sculpting messages and positioning your company to achieve a specific perception. Public relations must work in tandem with a company's advertising and Web strategies, providing greater brand position and stretching marketing budgets. Proper branding is never developed in isolation of one marketing function, but is built across the spectrum of corporate functions. By not integrating public relations with other communications disciplines, a company loses out on many opportunities to establish or strengthen its brand.

Every written communication issued by your company, from invoices to press releases, is an opportunity to strengthen your brand identity. For public relations to be effective in the branding mix, all written communication materials must be created in what is called the "brand voice." Brand voice reinforces a company's image and describes or clarifies a company's personality and distinguishing features. Brands evoke emotion or a connection with its audience that is portrayed visually and in written form.

During its launch phase, Cellmania.com wanted to be perceived as the best one-stop-shop for wireless products and services – a Web site that was easy-to-use and informative for consumers. Clear, bright language that was exact and written with a friendly tone helped reinforce this position. If public relations materials were written in an unclear, jargon-filled manner or were problem-focused rather than solution-focused, it would have clashed with the company's easy-to-use message and detracted from its brand positioning. Unclear written materials can lead readers to believe that your site is confusing and meaningless. What's more, if materials, such as press releases, are too convoluted, the chances of media pick-up, which is becoming increasingly more difficult, are nearly nil. Reporters, those on technology beats, do not have the inclination or time to slog through jargon-filled releases and then translate them in a complicated re-write for their readers.

How do you establish a brand voice? First it's critical that you understand and be able to define, your brand. Second, you need to identify the behaviors that represent your brand. For example, does your company aim to provide exceptional customer service, or will its main focus be to serve as an online resource for all? These are the questions you must ask as you identify the behaviors of your brand.

Once you've determined the substance of your brand, you will need to develop key messages that clearly communicate it and develop an acceptable writing style and tone. You will also need to identify your company's core business proposition and determine how to communicate the areas of difference between your company and your competitors. The last step is to make sure that your staff understands the brand, and that it is part of the company's culture. Ways to do this include holding employee workshops, especially on writing style for those who will participate in your company's written communications. Engaging in ongoing employee branding presentations also helps everyone clearly outline the brand and its coinciding policies. Brand voice should be reflected in employee manuals and orientation materials, office environment and even worked into employee rallies and other social activities.

Besides written communication, public relations may also include developing special promotions or guerilla marketing. These are additional opportunities to strengthen the brand. As an example, Cellmania.com's available-to-all position was communicated during a special event for University of San Francisco students during the Thanksgiving holiday. Cellmania.com established a booth that allowed students to use cellular phones to call home free on Thanksgiving Day. This event reinforced Cellmania's position of a friendly, wireless resource that has something for everyone.

Personalization is also important in every aspect of branding, particularly in public relations. It is absolutely necessary that media pitches be appropriately targeted and tailored for specific publications. For example, it makes no sense to send your press release to *TV Guide* if your primary business is to sell computer products, but it makes great sense to personalize your press release for *Cosmopolitan* magazine as a way for "Cosmo girls" to learn more about the vast array of modern tools for modern women.

Also, don't forget that hard-copy media are not the only valid forms of press coverage. Seek placement in online versions of traditional media as well as appropriate Web news pages. Consumers and investors who are online savvy often don't bother with traditional media and keep abreast of the latest news via online sources including *C/Net* and *Wired.com*. Wise dot-com public relations plans will include methods of achieving coverage in all appropriate mediums.

Building a Dot-Com Brand from Scratch

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Web strategy and page design are essential in building a dot-com brand. This component of brand building has the potential to create more traffic and sales for a company than either advertising or public relations. And don't forget that traffic or hits doesn't always yield sales. You need to offer a comfortable, yet enticing environment for results because your competition is literally a few clicks away.

One of the best ways to establish a leading brand is to be an innovator. If you are the first to offer a particular product or service online, that message should be part of your brand communications strategy. Cellmania.com was the first site to offer over 50 wireless phones and more than 10,000 service plans online, making the company different from its competitors, which offered a few phones and fewer plans for online purchase. That point of difference meant convenience for the customer, an essential element of Cellmania's brand.

Good Web strategy also includes selecting a memorable name, something that indicates what your company is all about. We chose the name Cellmania because it made reference to cellular phones, and it alluded to the fact that shopping for a cellular phone and service plan is hard, frustrating work.Cellmania.com brings sanity to the insane world of wireless shopping. The name is memorable and gives an indication of available products and services.

Creativity, especially when it comes to Web sites, is critical. Top Web brands like Amazon.com, iVillage or Yahoo! have fun sites that are easy to navigate. This encourages Web users to visit the site and entices them back for repeat visits. The creation of an excellent site should be one of your first priorities, and remember that speed is of the essence. If it takes too long to bring up a page or an image, your Web visitor may lose patience and leave. Keep graphics and copy relatively simple.

Another item to consider when developing a Web strategy to extend the brand is establishing solid partnerships and agreements. A fast-paced management team is necessary to develop business deals and secure partnerships that will allow you add value to your offerings, to better serve your customers and to reach additional customers. Partnerships and agreements also help provide public relations opportunities by providing a constant pipeline of news. A small Web brand can't make your company successful alone, and you have to be securing affiliate relationships, sponsorships, exclusive partnerships, portal deals and other business agreements. This continues to be an important strategy for Cellmania.com, and during the company's launch phase, establishing these deals and relationships helped provide instant credibility to the brand and provided access to a much-needed customer base. All successful Web brands have been built in part by successful partnering. A good example of this is Intel. An integral part of Intel's brand is the five musical notes and its logo appearing in every advertisement that features computers powered by Intel's Pentium processor. At Cellmania.com, our XML technology equips our traditional retail partners with the content and technology necessary to provide a wireless Web site to its customers. Our partnership agreements require the merchant to let its customers know that Cellmania.com powers the site.

It is also wise to get to know your partners and find out information on their various publicity opportunities. Cellmania.com has received several media hits on outlets such as CNN due to coverage received on our partners. Let your partners know that a company spokesperson would always be happy to speak to the press on various topics and news stories, if appropriate

The most important thing to keep in mind when building the Web strategy is that marketing on the Web is relationship driven. It seems to be faceless, but it can't be, especially for our customers and for the media. The company's CEO and other management heads must be available for press interviews and analyst meetings. Make it possible for customers to have quick-access to customer service and find a way to provide personalized information to individual customers. Cellmania.com's site allows users to find the perfect plan and phone by giving them comparison information on available phones and local plans that fit into their individual budgets and usage profiles. This personalization is invaluable and helps us to establish a strong relationship with our many audiences and is an important part of the Cellmania.com brand. The power of relationships, especially on the Web, should never be underestimated.

Web Learning: Flexibility in Corporate and Academic Education

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Abstract: Web learning incorporates traditional educational content and current technological innovations to form an easily adaptable approach to corporate and academic education. Web learning (or distance learning) allows students and teachers the opportunity to exploit the flexibility and functionality of distance learning. Web learning allows access to training and course material at any time or from any place. This panel discussion will explore web learning's role in three common environments: the corporate learning environment; supplemental classroom learning; and independent study.

Web Learning's role in education

Web learning has affected corporate and educational environments by transforming the manner in which learning is conducted. Traditional educational models are based on the exchange of knowledge and information from a teacher to a group of students in a face-to-face situation. Web learning, however, exposes learners to an environment where the focus of learning, excellence in the transfer of information facilitating a sound understanding of that information, is conveyed in a different medium. Web learning allows learners to use the soundest medium to save, store, and transfer information securely and quickly. Web learners take advantage of the most current technological innovations to aid them in their pursuit of knowledge.

The panel will discuss the three principal manners that web learning can be applied: to reduce overhead for business professionals; to supplement traditional classroom learning; and, for independent study.

Web Learning and the business professional

Due to the increasingly important role of the Internet in the business community, businesses are forced to stay abreast of the latest technologies and practices in order to compete in a high tech society. Web learning has proved to be a logical and practical choice in helping professionals take courses and helping businesses integrate new technologies and methodologies into their corporations.

Due to the low rate of unemployment in the country and the frequency of high turnover in companies, many companies are finding it easier to re-train valuable employees by updating their education, as opposed to hiring new employees. It is a more feasible and cost-efficient solution to re-train existing employees because it increases the likelihood of employees remaining loyal to the company and prevents the expense involved in employee turnover. Thus, when employers look at re-training opportunities, web learning presents itself as a complimentary solution. In addition, many organizations recognize the importance of web learning in corporate education because of two compelling reasons: convenience and cost.

First, the ability for an employee to work at his/her own pace is invaluable. Professionals are often hampered with the exhausting task of adjusting their work and social schedules around their classroom learning schedules. The commute to a college or university, along with the stress of balancing a full-time job with schoolwork oftentimes produces a weaker level of interest, commitment, and competency on the employee's part.

Second, web learning is one of the most cost-effective alternatives to traditional classroom education. Web learning follows the same tenets of quality in education, thus, the quality of the deliverable is not being changed, only the manner in which it is delivered. Overhead such as paper waste, travel time, etc., is reduced since distance learning uses the Web as its delivery medium.

The supplemental classroom tool

Traditional classroom environments are undoubtedly still the standard by which learning is measured. However, web learning is being used as a supplement to the traditional classroom environment. Web learning serves as an ancillary tool which professors can constantly update, monitor, and store information and assignments that are pertinent to a course, or even a specific class. And increases student to student interaction and learning.

Used for small to large classroom settings, web learning allows students to access, study, and understand information at their own speed. In any one classroom there emerges a variety of work techniques, learning styles and, skill levels. Web learning allows a student to use their own study skills and work habits, without penalizing them or allowing them to miss valuable information. Students also develop better work techniques, learning how to prioritize and organize their workloads.

With web learning, students in specific classes are allowed to access a forum that the professor has established for their specific needs. In that forum, students can read and download homework, readings, and other instructional tools. Students also have the ability to submit work or query a professor. A student also has the option of joining a discussion with other students and collaborating on various projects. This environment allows students to seek individualized help, as well as giving them continual access to the course.

Independent study

Distance learning represents a viable educational opportunity for many students who might otherwise be unable to enroll in a course. Many individuals find that tuition costs tend to be prohibitive while others find that they cannot commute to an institute of higher learning.

In the past, students relied on correspondence courses (the first true distance learning opportunities), self-teaching, or other methods of learning. However, web learning has emerged as a more efficient and current option for independent study.

One of the most important reasons that web learning enhances a student's learning is because of the technology involved. Technology has burgeoned and developed to the point where computer systems are economically feasible for many students and universities. With technological advances such as streaming video, audio, and graphics, distance learning programs have the ability to remove students visually and acoustically from their environment and into the material they are learning. The World Wide Web opens access to an infinite amount of informational resources and aids for students. The quality of technology available to students in computer format guarantees that the level of educational quality will not diminish. Students have the added benefit of technical support services, as well as the benefit of dialoguing with other class members, allowing students opportunity to tap into a wealth of resources outside of the classroom.

Web learning provides students an opportunity to access many of the tools that they cannot access within a classroom setting.

How To Teach Differently: Using Technologies for Web-based Courses

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Abstract: This panel describes the development of an online course software application: Blackboard CourseInfo. CourseInfo is form-based software, which can be used through a web browser. By using the web-based templates, faculty can create online courses and deliver instructional materials more easily than with an HTML editor. In describing the development of CourseInfo application, the panelists presents four uses of technologies to serve instruction at Ohio University: Multimedia and Internet applications, usage of a software template, online independent study, and faculty development/support by information technology staff.

Introduction

From the research and literature review, we know that the Internet and multimedia technologies can engage students in gaining the abilities of active participating, higher-level thinking, interdisciplinary usage of knowledge, and interactive reflection of course content. Particularly with faculty creating and implementing online materials, instruction with technology, no matter whether classroom or online, creates truly integrated activities for students to learn the subject concepts.

Pain Management Course for Nurses – Denham

A mission of the School of Nursing RN to BSN Program at Ohio University has been to provide baccalaureate education to registered nurses in rural southeastern Ohio using a variety of distance learning formats. The Ohio Learning Network has been used successfully since 1986 to connect the main Athens campus to five regional campuses in order to deliver nursing courses via a microwave satellite system. About four years ago the use of compressed video became available and has been used successfully for distance learning. Within the last two years CourseInfo has been made available by the university and provides a way for faculty to use the Internet for course delivery. Thus far, CourseInfo has been used to make courses more interactive and provided a way to deliver supplemental course materials and additional resources for some nursing classes.

A four credit hour elective course on pain management has been available to nursing students in the program for about six years and meets their upper level biological science requirement or counts toward elective hours necessary for degree requirements. The course has recently been modified from a didactic experience delivered via distance learning to an asynchronous Internet course that students can access from home. After one and a half years in development, the course was piloted during winter 2000 with a group of 21 nursing students. Asymetrix Toolbook was used as the software for designing the course. The faculty who developed the course is self-taught in computer technology and had no previous experience in designing Internet coursework prior to this project. As prerequisites, students must have completed an introductory computer course or be able to demonstrate proficiency in word processing, e-mail, and Internet use. Each student must have access to a computer and arrange for Internet access either through their student accounts or local providers. Need for computer assistance is to be fulfilled by students, but tutorials are suggested where additional learning can be accessed via the Internet. The course includes:

- Weekly reading assignments that are supplemented by web-based course content. Interactive learning is encouraged through the use of multimedia, the Internet, critical thinking activities, student collaboration, and guest faculty.
- "The Virtual Classroom" provides a place for students to arrange synchronous and asynchronous chat times with fellow students, respond to critical thinking activities, interact with guest faculty or conduct "virtual office hours."
- "The Teacher's Forum" is a place where faculty can post messages, updates, and information related to the course.
- The "Collaborative Learning Center" provides a place where students can interact with one another synchronously or asynchronously as learning teams while they work on their group projects. Teams are assigned space that can only be accessed by the team members and faculty. Group projects are submitted electronically.
- "E-mail" is used for faculty-student and student-student conversations.

Rather than passive learning and pedagogy, students become participatory learners through the use of electronic media. Project based assignments, critical thinking skills, weekly quizzes, and cooperative learning enhances learning as faculty and students engage in a virtual learning community. The learning experience includes holistic, cultural, legal, ethical, and advocacy perspectives of pain management. Computer technology and the Internet are used to foster knowledge acquisition about pain management and asynchronous learning enable students to learn anyplace and anytime. The faculty as tutor, facilitator and mentor guides the learning experience through the use of a text, a web-based course, Internet resources and interactive engagement in the learning experience. Students assume responsibility and accountability for independent learning.

Some evaluation data have been collected from the piloting of the course, but are yet to be analyzed. The course is currently being edited and steps taken to eliminate some problems identified with delivery. The course will be available annually to students and plans are pending to make pain modules nationally available for continuing education for nurses. A demonstration of the course will be available.

Web-Enhanced Instruction – Henderson

Blackboard CourseInfo can be used to offer a course on-line or as a web-enhanced addition to a course. The CourseInfo software became a vehicle for me to explore several beliefs. I wanted to participate in some form of distance education. Secondly, I believed on-line instruction could offer students and myself a flexibility that traditional classes could not. Third, I believed nursing students needed to gain experience in testing by computer prior to their licensure exam for registered nursing. I have been offering college courses as web-enhanced since the fall of 1999. As a result, nursing students have gained experience using their university email accounts, the Internet, and the CourseInfo course site for Pharmacology II.

I was part of a group of thirty faculty who participated in the pilot group trained to use and implement CourseInfo. Once I had learned the basics of using the form-based software, I began thinking about how to format my course for a distance learning approach. I began by enhancing my course with material and activities placed on-line and testing on-line.

I uploaded my syllabus, course objectives, weekly objectives, weekly class topics, and reading assignments to CourseInfo course. I created a course structure set-up to match each week of the course and called it weekly assignments. For each week of class I uploaded copies of all handouts given in class. This helped students by offering them an electronic copy they could refer to anytime they could access a computer with Internet capability.

Another feature I added to the weekly assignments was critical thinking questions. This enabled students to gain experience applying the content covered in class or reading assignments. By the second time I offered the course, I progressed to adding a small number of points to the course grade devoted to "Internet Activities." Students began receiving credit for accessing the weekly assignment and completing whatever activity was requested. I created study questions to help them study for exams, more critical thinking activities to challenge them to apply concepts being learned, and practice exams so students would be familiar with the exam function in the software, and group work. One group assignment I devised required students to access the assignment for the week, find out their group assignment, communicate electronically within their groups, solve a critical thinking question, come to a consensus, and post the group's answer on the Discussion Board for all groups to read and respond to. I was able to track the participation of each student and each group.

At first I had students take tests together in the computer lab. I included rationale for each correct and incorrect answer and set the software to allow students to review their exam. This permitted students to obtain immediate feedback on their exam and has been received very well by students. I started allowing students to test from any location during the second quarter I offered the course. I was able to make the exam at a certain time and set the exam for a certain number of minutes. A great feature for me, as an instructor has been the ability to have grades automatically transferred to the on-line gradebook. I have been able to modify or enter additional grades as necessary and students have been able to track their grades any time they wish.

Web-Based Independent Study for the National Council Licensure Examination – Parker

The purpose of this approach was to develop an independent study based over an Internet web site to provide nursing students with a review course for the National Council Licensure Examination (NCLEX) in a convenient manner. The NCLEX is the examination that all graduates of nursing programs are required to pass to become a licensed registered nurse (RN). The students have access to the Internet in the following ways: personal computer, nursing and general computer labs, and public libraries (which are open on the week ends).

A one credit hour elective course for NCLEX review has been available to nursing students for four years and counts towards elective hours necessary for degree requirements. The class had been taught in the traditional method of classroom didactic and clinical skills review. The Blackboard CourseInfo a web based authoring program was used to design the course. The Blackboard CourseInfo authoring program incorporates the following preset menus: announcements, course information, staff information, course documents, assignments, communication (e.g., email, Discussion Board, etc.), external links, and student tools (e.g., check your grade). The Blackboard CourseInfo had been used as adjunct tool in other nursing courses and the students were already familiar with the program. The course includes:

- Web-based course content, discussion, assignments, and quizzes.
- "Announcements" is a place where faculty can post announcements, messages and assignments.
- "External links" refers students to other web-based sites.
- "Discussion Board" provides a place topic can be discussed and faculty and students can post their comments.
- "Email" was used for faculty and student communication.

Since offering web-based enhancement in other courses and in this independent study, I believe that the Web course has fostered the independent learning of the students. It also has enabled faculty to give more individual attention to the students requesting further information because of the convenience of communication through emailing.

Evaluation results of the course are not yet analyzed. The course is presently being revised and modified to correct problems identified during the implementation of the course. The evaluation results and course presentation will be available.

Faculty Development & Support – Bi & Mehta

From August of 1999, the Center for Innovations in Technology for Learning (CITL) started faculty development with Blackboard CourseInfo Pilot Groups (three groups). Each group which consisted of ten faculty members attended the one-week workshop. They were from a variety of disciplines from all campuses (Ohio University has a main campus and five regional campuses, which are located throughout the southeast Ohio). The workshops covered the basics of preparing and creating electronic files, instructional design considerations, the features of CourseInfo and the use of these features to serve course objectives and goals.

When the fall quarter began, the Pilot Group faculty launched more than thirty courses with CourseInfo, most of which were web-enhanced for classroom teaching. The CITL also collaborated with other information technology services on campus to ensure the smooth application of online instruction. We worked with the Computer Services for campus public computer labs upgrade, and with the Support Center at the Communication Network Services for user support (both faculty and student users). In order to support more faculty with technology application and online instruction, the CITL also collaborated with the information technology staff at regional campuses for various issues in technical and instructional applications and support. At the time of this proposal was written, we had provided thirty-four times of 3-hour and 1-day CourseInfo workshops at all Ohio University campuses. The university developed more than 500 CourseInfo courses with over 8,000 users for the online courses. A number of these courses were offered for distance students in the external degree programs as well.

Initially the CourseInfo 2.0 was installed on a Sun Server. The Sun Enterprise 250 was configured with 512 MB RAM, 250 MHz dual processors, and six 4 GB disk drives. The Pilot Group was trained using CourseInfo 2.0. During early fall, CourseInfo 3.0 was released, but we had to wait till the end of the quarter to upgrade. Even though 3.0 had many new features and lot of bug-fixes, there were still problems that faculty, students, system administrators and support personnel faced in an academic environment. From the experience gained during the pilot study, faculty feedback, CITL thorough evaluation, and use of the software, a web-based FAQ was developed using Allaire Forums. The web-based forum is a place where faculty and student can visit again and again at their own time and pace to find solutions, work-around or hints related to their problems. The FAQ is constantly updated as new problems are reported by faculty/students and solved by the CITL. A listserve was also created which provided a second channel of communication. This channel is mainly used to provide faculty on pressing issue related to CourseInfo and the server. Since the listserve is email-based, the faculty would immediately get the news. Currently we are ready to upgrade CourseInfo to 4.0 on a new Sun Enterprise 3500 server. The new server was configured with 2 GB RAM, four processors, and RAID system with 72 GB disk array and full redundancy to minimize/eliminate failure and downtime.

Summary

The members of this panel represent diverse backgrounds and experience in university level education. The perspectives of the panelists are from the fields of nursing, health, medical care, humanities, instructional design, educational technology, web development and system administration. The driving force behind the energetic enthusiasm of this panel has been the creation of effective instruction with technology and helping students to learn. Based on our own experiences with teaching and learning, we will share our knowledge with the larger community at the WebNet Conference.

Learner Fulfillment Online: Strategies for Tomorrow's Educators

A Paradigm Online Program at Continuing Studies of the University of Toronto

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Abstract: Discover the School of Continuing Studies of the University of Toronto and its paradigm example of a unique online certificate Professional Translation for the Workplace English/French program where adult learners receive responsive, expedited learner care from their dedicated educator. The University of Toronto School of Continuing Studies provides customized feedback and one-on-one learning assistance tailored to each individual learner, thus optimizing progress, mastery, long-term memory retention, and learner satisfaction. With no technical or pedagogical shortfalls to date, this online program enjoys success largely due to the University of Toronto School of Continuing Studies' unwavering commitment to learner care and learner fulfillment, thus making this online certification – which is relevant to current professional needs – an attractive and realistic alternative for busy, active adults. Explore with us the provision of unfailingly reliable and practical online learning resources and customer service-minded education which is only a mouse click away.

The University of Toronto School of Continuing Studies has been in operation for over one hundred years, and has been providing distance learning opportunities for over fifty years. In 1998 we launched the *Online Certificate in Professional Translation for International Trade English/French* which today enjoys unprecedented growth in enrolment of bilingual adult professionals the world over who are upgrading their professional expertise.

The University of Toronto School of Continuing Studies has a strong tradition of responding to customer needs but intrinsic to those needs is our dedication to pedagogy. Here is a paradigm example of our online pedagogy as it is currently provided in our *certified Online Professional Translation for International Trade Program - English/French*. This "case in point" will highlight the provision of learner fulfillment within this 3-course certificate program offered to adult professionals locally, nationally and internationally at the post-university level.

The University of Toronto School of Continuing Studies' *Online Professional Translation for International Trade English/French Program* has been offered for three years and is growing apace. Individuals from Ontario, from Canada, from the U.S. and from all over the world earn in less than a year a certificate in workplace translation –24 hours a day, 7 days a week– without major interruptions in their lives. These professionals, many of whom are North Americans employed abroad, receive responsive, expedited learner care from their dedicated educator who is their coach and mentor throughout the program. The University of Toronto School of Continuing Studies provides customized feedback and tutorial assistance tailored to each individual learner in order to optimize progress and learner satisfaction. To date, no technical or pedagogical shortfalls have occurred and learners have evaluated their learning experience as "very satisfactory" to "outstanding". This online program is successful largely due to our unwavering commitment to learner care and learner fulfillment, thus making this online certification – which is relevant to current professional needs-- a realistic alternative for busy, active adults. The key to learner fulfillment in this program is our providing unfailingly reliable and practical online learning resources and a customer service-minded educator who is only a mouse click away.

In our view, the critical success factors in the delivery of online learning, are the provision of personalized and customized learning experiences through the management of educational systems and the re-framing of the adult educator mindset. Through this online translation program, the School demonstrates that it is in the business of offering well-defined and parameter-driven personalized customer services to learners and will be diplomatically managing the expectations of learners and the relations of learners and their adult educators.

Online Delivery Findings for the Online Translation 3-Course Certificate Program

The findings will be discussed under four headings : Technology, Quality, Instructor Resource Time and Access. The conclusion will address the benefits arising from the delivery medium and from the approaches employed in its delivery.

Technology

The courses, accessible through most web browsers, run on an Oracle/Sybase customized platform and are written with Java Script. To complete our online offerings, participants must have the following system set-up:

- A Pentium class personal computer running Windows 95, Windows 98, or Windows NT;
- 16MB RAM or greater;
- A 28.8 modem at the minimum;
- Either Netscape 4.0 or Internet Explorer 4.0 browser software.
- A reasonably current version of Microsoft Word or WordPerfect for sending e-mail attachments.
- An e-mail account, and one's own Internet access through an Internet Service Provider (ISP). The learners are responsible for securing their own accounts with an Internet Service Provider and these communication charges are not included in the course tuition or fees.

When designing the courses, allowances were made for the fact that students may have slower Internet connections, etc. The use of streamed video or audio are not necessary pedagogically in order to deliver the academic content and thus their use is postponed until accessibility to such media-based enhancements is available to a majority of computer users as part of their off-the-shelf computer. The server has been down only twice in three years for approximately 48 hours each time. Server stability is critical to the viability of online courses as products.

I have observed the following during the delivery of these courses :

- The most persistent problem was the lacunae of several students to remember their password and user name. We are implementing a URL based service through which, using one's student number, learners may access their own passwords. In general, technical support for online distributed learning offerings needs to increase so that resolution of problems is on a 24hr basis. When the server is down or a glitch has occurred, learners and instructors need to be informed officially and expediently when everything is up and running again. Phone communication, e-mail, fax and mail are all recommended mainstays for communication. Year in and year out, we have experienced no technology-related problems and as a result the response to the program has been exceptionally positive.
- The content of the courses should remain fixed for the duration of the course for that particular individual learner so that pedagogical integrity is maintained. Between offerings revisions may be made so that refinements and suggestions to content may be incorporated.
- Learners recommend *on-going enrolment* in online education courses so that the term begins when they register and so that they may move through the material at their own pace for a set period of time. We have great success with on-going enrolment which supports the online learning mantra of anywhere, anytime, anyplace.

In brief, from a technical perspective, delivery of online distributed learning offerings, requires an on-going commitment of resources (both human and technical resources) in order to build and maintain the reputation we now enjoy of delivering a quality learning experience customized at the level of the individual learner.

Quality

The quality of our certificate translation courses stems largely from the instructional design in that the learning activities are are experiential, non-linear, and goal-oriented. Upon completion of the online translation certificate, I ask students to fill out course evaluation forms. A ten point scale is used to measure levels from Poor (1) to Excellent (10).

- 100% ranked the courses as a 9 or 10 in terms of the students' satisfication with them as a learning experience.
- 100% ranked the courses as an 8, 9, or 10 in terms of having their expectations met in these courses.
- 100% ranked the instructor and instructor feedback as a 9 or a 10.
- 100% ranked the quality of the translation activity assignments as a 9 or a 10.
- In response to the question, would you recommend this online certificate to someone else, 100% said yes.
- 100% are comfortable using e-mail to submit activities by document attachment.

When asked about what they communicated through e-mail,

- 96% dealt with the assignment submission and content learning queries about the learning activities.
- 4% or less dealt with user name and password reminders.

When asked to give written comments, students have provided the following :

"My biggest personal challenge was overcoming my poor time management and organizational skills, sitting down, doing the learning activities, then getting online to blitz studying and then completing the assignments."

"The only downside is that speaking (voice) communication can only be done on the phone which the instructor provides five days a week, 8 hours a day."

"These courses are innovating teaching with applied computer technology for learning a skill like language translation. This makes for an excellent way to learn - and all on your own time for busy people like myself."

"Being able to pick times most convenient for me for doing my learning and to do it at home is very attractive. The online learning mode without glitches technically is very good for learning translation skills."

"Truly effective learning takes place, all with insights from your instructor who is your personal coach and mentor! If students have computer ease, learning this way is ideal."

Maintainence of Quality : Recommendations

Our high learner participation and high completion rates in a web-delivered learning offerings are directly linked to high motivation and ease of use. Web-delivered distributed offerings for adult learners ideally should be offered as part of a certification program or a path of study and should be free of busy work or rote learning of any kind.

Instructor Time

As the instructor and mentor/coach, I make a conscious effort to batch my responses, to limit my synthesized feedback on learning activities to one e-mail screen per activity per learner, and to efficiently manage phone and written communication. As a result, I find that I spend less instructor time than when I teach the same three courses in the paper-based format. E-mail communication is quicker than phone help-line communication. I am able to copy the answers to frequently asked questions from a Word file of common answers which I am not able to do as easily when I respond in hand-written form on paper-based assignments. I recommend providing instructor training on how to efficiently and effectively instruct on-line distributed learning offerings with a skills-training focus while still giving attention to affect and learner fulfillment needs.

Access

It is our intent to increase access to the University of Toronto School of Continuing Studies and to provide high quality, critically needed professional development in workplace translation skills training by providing online courses with a high degree of ease of use. I believe that we have discovered that it is technically feasible and that the quality of the individual learner experience and instructor feedback may remain high. Marketing our on-line courses to a highly computer literate and Web literate segment of the population has be crucial to our success, for these are the very individuals who will derive the most satisfaction from an online learning experience. Once the students become comfortable with our simple, stream-lined online course delivery mode, they are comfortable taking the next course in that program of study in the same delivery mode. We have reached and have satisfied national and international niche markets of students who otherwise would not have access to the School's programs.

Benefits Arising from the Approaches Employed in Our Online Learning Delivery

The general benefit of our online translation program is that an adult learner may spearhead his/her own learning experience at his/her own pace and on his/her own schedule with significant personal feedback from an expert instructor/mentor which affords the learner the opportunity to master and retain, in long-term memory, learned skills and strategies.

Conclusions

One-on-one e-mail between educator and learner and e-mail exchanges between all stakeholders (learners and educator/mentor/coach) in the case of our translation program provides us the opportunity to move us closer to achieving a pedagogical ideal. Based on our experience with our online translation program, we venture to suggest that online learning of the future will create a set of new assumptions about online learning delivery:

- ***Learner care.*** Technology provides us with the opportunity to finally meet an individual's education needs. Learning organizations that provide, with guidelines, personalized adult educator response, feedback and customer service will have higher online program completion rates, higher learner satisfaction ratings, and higher learner retention. Learning organizations will have a repository of learner data and learner-educator interactions so that fine-tuning of online education delivery is possible.
- ***Multiple touch points.*** Learning organizations will assure consistency and quality of educator-learner communications across the multiple touch points of telephony, i.e., e-mail, asynchronous and synchronous web-driven interactions as well as traditional communication channels. We cannot emphasize enough that more than sufficient human resources must be dedicated to servicing all communication channels in order to ensure that no breakdowns of communication occur, ever. This is not an insignificant requirement for the delivery of learner fulfillment.

- ***Personalize, personalize, personalize.*** Learning organizations and adult educators will devise flexible communication systems to manage learner expectations and achieve cost efficiencies while leveraging educator-learner contact, within parameters, to optimize the online learning experience.

In our online translation certificate program, learners have come to expect and enjoy optimized learning experiences due to learner-educator interactions that will occur, with parameters and ground rules, across multiple touch points. Adult learning principles are mined to serve professional education and continuing education learners and customers and will be applied in the form of personalized learning solutions and services, the ground rules of which may vary from learning organization to learning organization, from adult educator to adult educator, and from offering to offering.

Adult learners in our translation program are treated as valuable customers. The flexibility, customization and work with the adult learner "in the way that s/he prefers" drives our online pedagogy. The adult educator's attitude is key. Learner-care and attention to facilitating learner fulfillment are the cornerstones of the educator's approach. Tremendous flexibility within the learning experience is our motto. With the customer service attitude of the adult educator as paramount, our translation certificate learners create their learning environments that evolve iteratively and intuitively.

Learner-centered offerings such as our online translation program have required the adult educators involved to shift their priorities and their roles. In the future, the primary requirement to achieving effective online education will be that learning organizations and adult educators make this shift. Of equal importance, the roles and expectations of all stakeholders in the management and administration of this environment will require re-definition and alignment

Currently the School's *Online Professional Translation for International Trade Program* delivers optimal learning experiences and value to the learning customer, and thus continues the School of Continuing Studies' unique tradition of delivering learner-centered educational opportunities to learners at a distance.

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SHORT PAPERS

Pioneer Project: Developing Online Collaboration and International Partnerships

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Abstract: Project Pioneer, being developed at Teachers College, Columbia University is a partnership with the Institute for Learning Technologies, Columbia University; Colégio Bandeirantes – São Paulo, Brazil; and Beacon School in New York, to expand its research and methodology to international levels. The project is developing a model to both research and develop emerging technologies tied in to education and curriculum.

Creating Online Partnerships

This project is an initiative to create an online collaborative distance environment backed up by the most innovative and sound pedagogies, as well as a testing ground for new collaboration tools for students and project developers. In designing this project, our goals are to:

- Research innovative uses of new technologies applied to education
- Build a rich collaborative environment for research and simulation
- Use technology to promote new pedagogies (constructivism)
- Create an environment that supports student performance by providing social support (interactions in virtual reality and streaming technologies); easy access to reliable stored information (web); attain competence in high level thinking skills and problem solving; good affordance and task support (Self/R – open source through concrete interface – students work with objects). (Rothkopf, 1998)
- Work with partners to create a network of resources to improve the quality of Science education globally, using distance-learning techniques to integrate researchers and classroom teachers, as well as developers of professional development materials.

The approach is global where students do most of their work and collaboration online. The site was designed for guidance through information and references, adopting initially a *Webquest* format, as well as a tool for collaboration, through listservs (http://www.egroups.com) and a forum.

Project Pioneer will be a test bed for new technologies as well, using the Merlin (http://www.merlintec.com) computer as an educational tool, giving students access to an open source operating system - OS (Self/R) that allows them to take ownership of their learning process, not being limited to closed OS's. We are also developing the distance component for the Earth To Class Project (http://www.earth2class.org) at Columbia University, an initiative to bridge the gap between researchers at Lamont/Doherty and K-12 teachers. The workshops are being taught at the Lamont seminary room, but being transmitted live through videoconferencing to Adirondack Community College in North Hudson, NY (200 miles away).

One of the main goals of the Pioneer Project is to integrate such collaborative and research tools into everyday educational activities. Through the Mars Millennium Project (www.mars2030.net) we hope to create a very friendly collaborative user environment that will empower the students to become real researchers. The research I have found supports us in this pursuit. "Will this use of the Internet enable students to do something that they COULDN"T before? Will it allow students to do something that they COULD do before, but BETTER?" (Harris, 1998) These are questions we are constantly asking ourselves. We don't want to use technology for the sake of technology itself. We want technology to be a tool to empower students, not to control them.

Environment Created -- Implementation

The Website: http://www.projectpioneer.com
Task: Webquest format - Constructivism at work (http://edweb.sdsu.edu/webquest/webquest.html)
We chose the WebQuest format, due to the fact that it lends itself to an interdisciplinary approach, as well as authentic learning situation, where the students become researchers. Our goal was perfectly summarized in one of the emails I received from one of the major specialists in the integration of the Internet in the classroom: "The ultimate goal is, through the use of WebQuests and other tools, to develop students capable of posing and solving their own essential questions, and proceeding without the benefit of scaffolding. Going beyond WebQuests means that students would recognize that any problem must be attacked from multiple perspectives. They would have the skills to recognize the critical roles necessary to solve a particular problem. They would define their own roles, locate their own resources, and form the questions that would allow them to pursue their role. Then they would develop individual expertise based on their roles, come back to the group, and the process of problem-solving, share what they had learned, and together construct a new body of knowledge that may not have existed before." (Wolinsky, 1999)

The model we chose is also in accordance to research by Johnson et.al (1993), in integrating cooperative learning through emphasizing lesson coherence. The prepared lesson has a beginning, middle, and an end. To begin the lesson the teacher presents a practical, real world problem or provocative issue that intellectually challenges students. Everything that follows is organized around solving the problem. The problem is presented first. Then concepts and rules are presented second. Teachers pose provocative questions and allow students to adequate time for reflection. (Johnson et. al, 1993)

In this particular activity, we also decided, based on previous experience and supported by research (Johnson et. al, 1993) to assign specific roles, as a scaffold in an initial phase, so that students wouldn't get lost when starting their vast research, and were confronted with the great amount of information available to them. According to Johnson et. al, the teacher assigns students roles. After each item, the roles are rotated so that each student fulfills each role once. (Johnson et.al, 1993). By following this format, the students would be exposed to different responsibilities and perspectives, acquiring a more global view of what is required of them, as well as practice different uses of the online environment, becoming more savvy with the technology.

At this moment (July 2000) the project is in progress. The students in Brazil and in New York have finished their first model of a colony, using Flash from Macromedia (www.cyrenum.com/genesis). This is the result of one semester of much research and group collaboration, both online and off-line.

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How the Wild Wide Web was Won: Online Web Developer Training

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Abstract: As the Web grows in importance in institutional settings, so does the need for training. Universities are looking at the daunting task of putting more information and services online. New professional roles and duties are emerging that include managing Web content and systems. This online Web training effort is geared toward addressing a specific strategic approach to staff shortages, training, building campus competencies, and controlling costs. It enables full-time staff to quickly learn processes and competencies to maintain their own campus Web sites, and provides a means for them to train part-time students to aid them in this task. Design standards and protocol can be incorporated into the training, enabling the campus to increase levels of production and maintenance that meet university strategic goals and policy. The trust and use of students can be an effective use of resources. The development of this program by staff for staff is testimony that students should be used to contribute to the mission of the university in strategic ways.

The University of Central Florida is a metropolitan university that has embraced distributed learning to meet the needs of its rapidly growing, diverse student population. Online courses and Web-based student services are being created at a pace that requires constant recruitment and professional development of staff. A distributed learning approach to training has been created as a means to train new staff and build a campus-wide network of part-time students to create Web sites and services. The training is online and is designed for self-paced study, but can be used in teams. The training course involves modules that sequence activities building on scenarios and simulations to increase quality and productivity. Full-time staff work individually with part-time students to build competencies that transfer between the centralized Web development group and campus departments and faculty. Trainees learn to create high-quality Web sites, provide technical support, and work with expert teams to better manage knowledge and control costs.

UCF has been recognized for its award winning faculty development in the use of technology for teaching and for its distance learning program. The Techranger staff training course is another strategy developed in response to increase support for faculty development and distance learning programs. Some institutions follow a model where faculty are expected to learn everything necessary to produce their own web-based materials for teaching online. UCF has adopted an alternative to this "craft" approach by using teams to provide professional assistance. We call our virtual course development team the Techrangers (as opposed to the "loneranger" approach.) Techrangers are usually students recruited from technical programs such as Engineering and Computer Science and also from the LEAD Scholars and Honors Programs. Working under the supervision of full time staff, Techrangers build courses for faculty and provide orientation, training, and technical support to students. The Techrangers take pride in developing learner support for using campus technologies to improve learning. As the need for online courses grew, so did the need for our internal training of Techrangers. As a result, the Techranger Certification Training course was designed to train new employees in performing the tasks necessary for creating and maintaining on-line courses and web sites for the university.

The course is divided into modules with tutorials and hands-on activities. These include training on office procedures, computer network setup, GroupWise, HTML Basics, web development software used at CD&WS, workflow, Unix, The Reach Server, WebCT, and Technical Support. Each module has hands-on activities for the trainee to demonstrate his newfound knowledge. These activities may involve using a piece of software, creating course content, or completing a quiz. The trainee must complete each activity successfully before the trainer or supervisor will sign off on that section. This is a pass-pass course. The trainer reviews each completed activity. If there are errors, the trainer points these out and helps the trainee correct them. Once all activities have been completed successfully, the trainer or supervisor signs off on that section. The trainer must sign off on all sections and the trainee must sign the checklist before he can receive certification. Upon completion of the Techranger Certification Training course, Techrangers are able to:

- Comply with all CD&WS office policies.
- Acquire access to the CD&WS network and setup all necessary tools.
- Perform the various GroupWise communication tasks used in the CD&WS unit.
- Explain the work flow process.
- Perform the various GroupWise workflow tasks used in the CD&WS unit.
- Create a hand-coded html document demonstrating basic html skills.
- Use the various software programs commonly used at CD&WS.
- Demonstrate basic Unix skills.
- Create, customize, and update a course and its components.
- Appropriately answer tech support calls.

Interest for training outside of our department began to emerge after faculty were depending on Techrangers to help support their classes. Many faculty have graduate students maintain their classes or web sites and felt the Techranger Certification would benefit their students knowledge of how to maintain online courses. Thus began the process of expanding Techranger Certification to include not only our department, but also campus webmasters and students maintaining online courses. To meet this need, the Techranger Certification course will be divided into different tracks that provide more customized training for the different audiences. These tracks currently include:

- **CD&WS Track:** This track is for internal training of Techrangers within our unit as specified above.
- **Student Assistant Track:** This track offers the same type of training as the CD&WS track for students working for other departments at UCF who wish to maintain their own courses or web sites. The CD&WS track would be modified to include more general training to maintain online courses without the CD&WS specific training, such as office policies and protocols.
- **Faculty Track:** Similar to the Student Assistant Track, this track helps faculty and staff in maintaining their own online course or web site properly.
- **Professional Programs Track:** This track is geared towards departments, companies and institutions outside of UCF creating and maintaining online courses or training. The training provided through this track would be more general and on a "best-practices" basis.

Study on the Transfer of Teacher Online Collaborative Planning To the Classroom Setting

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Abstract: This paper is a study of a year-long project for classroom teachers, which focused on the transfer of technologically-based, collaborative planning to implementation in the classroom environment. The project centered around the two following objectives and outcomes: (1) Authorization to use Learn NC online resources for lesson plans and materials, following the submission of individualized lesson plans to the site; (2) Implementation and presentation of submitted lesson plan in the classroom setting, as observed by a mentor or school administrator, providing a systemic approach from an educators' workshop to integration in the student learning process.

Overview of the Workshop

The year-long staff development included all teachers, media-coordinators, and counselors in a small, rural school system in western North Carolina (226 total). In order to successfully complete this workshop, each attendee was required to attend all four days of the workshop, create through collaboration a lesson plan for submission, and present the lesson in the classroom setting. These workshops were scheduled at various times throughout the school year. Each session trained between 30 to 40 educators from all grades, subjects, and area schools. The participants trained in the computer lab on the college campus. This particular environment provided the educators with a setting away from school stress with the space and freedom desired for a productive, creative planning environment.

Schedule of Workshop

The first day and continuing into part of the second day of the staff development, the educators received training necessary for certification and provision of a Learn NC account name. This account verifies appropriate training for the use of this online teacher website and access [illegible] its secured areas which contain tested lesson plans and other resources for teachers. Learn NC, or Learners' and Educators' Assistance and Resource Network of North Carolina (Walbert, 1999), is a collection of teaching and learning resources for students and teachers of North Carolina. The purpose of the site is to provide links and collaboration for educators across the state, as they involve entire communities in the process and progress of education. Links include libraries, museums, and universities as some of the learning resources. These links include access to both state and national forums, educational news, and required state teaching objectives and goals. Multimedia resources provide collections of text, images, and sound relating to across the board curriculum, and a professional development resource for online courses is being developed. Even though the training of the teachers involved in this study explored all of the areas of the site, we focused particularly on the Lesson Plan Database, which requires the assigned account name for access to a collection of lesson plans submitted by teachers across the state. Educators may gather ideas, download plans, and submit their own plans through this link. The Lesson Plan Database provides a vehicle for collaboration on all subjects and grade levels for educators in the state of North Carolina. Following the training, all participants were required to submit a lesson plan to this database, which critiques and returns feedback to the person submitting the plan. Plans have to meet certain criteria throughout the review process in order to be posted on the site.

Day two of the staff development reviewed the technology goals and objectives for teachers. All the participants in the study had previous technology skills training; however, the educators were on various levels in this prior training. Specific reviews, which were later used in the end product, consisted of general competencies for word processing, methods for exploring the Internet, creating active links, and basic power point presentations linked to the lesson plan. In addition, reviews on the uses of technical media were provided and participants were encouraged to make use of these components within their lesson plan. Particular interest centered around the use of a digital camera, scanner, and Smart Board. Registration for the sessions did not group the participants by the level of previous knowledge or training, but purposely grouped the individuals in a diversified manner. This process was evident through a technology skill pretest administered to all participants prior to the workshop.

Days three and four provided educators with hands-on time to explore, create, and collaborate the many sources and ideas for their intended lesson plan. The Learn NC lesson plan format provided the outline and process of the lesson plan procedure. The final day of the workshop allowed for the participants to present their plan to the group, using the Smart Board in the working computer lab. Educators were expected to complete the lesson plan within these four days and to either submit the plan at that time, or to submit the plan following the presentation in their classroom.

Results of Workshop

As previously stated, this staff development included all teachers, media-coordinators, and counselors within this school system. The system consists of six elementary schools (K-5), two middle schools (6-8), and one high school. It is a small, rural system located in the southern Appalachian Mountains of western North Carolina. Since most of the presentations and lesson plans were to be observed by administrators, the system required school level administrators to take the first day of the workshop, prior to this study, in order to have a better concept of the end product implemented into the classroom setting. Following the class presentation by the participant, administrators were to evaluate the plan and presentation with the educator and then report to the central office personnel a count of those who completed all components of the workshop. Administrative training results are not included in the results of this study.

An initial technology skills survey was administered. This general survey pertained to knowledge of word processing concepts, spreadsheet concepts, database concepts, presentation software, telecommunications, software integration, access and use of resources found on the Internet and World Wide Web. Eight percent of the participants were in the Level I category (insufficient skills to use computer technology), forty-five percent were in Level II (demonstration of entry level skills using computer technology), thirty-five percent were in Level III (comfortable with typical use of computer technology), and twelve percent were Level IV (sophisticated skills; capable of replicating). As this is an on-going, progressive project, these results will continue to be compared with initial surveys this upcoming school year.

Ninety-one percent of the educators reported that the staff development provided methods for transferring knowledge and skills to the classroom, ninety-one percent reported that their knowledge of the subject was increased, and eighty-five percent reported that their ability to use the technology increased. Due to the success of this program, future plans include extending staff development in these areas in order to continue and increase the integration of technology in the school setting.

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INTEGRATING COMPUTER ETHICS ACROSS THE CURRICULUM

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Abstract: Students will be more responsible than ever for their own learning in this millennium. It is our pedagogical obligation to insure that the integration of technology will enhance the learning environment. The integration of computer ethics across the curriculum is critical because technology will be integrated into every aspect of a student's life and the 21st century learner will be a life-long learner. This paper provides a format for professors to generate examples and assignments that are relevant to their curricula, as well as specific examples that maybe incorporated into many courses.

The coming of the new millennium encourages a new vision in education. The accelerated growth in technology is leaving a substantial impact on the learner-centered university of the 21st century. Online distance education will grow in popularity and instructional technology will be incorporated into courses in the traditional classroom more than ever before (Ben-Jacob and Levin, 1999). The concept of hybrid courses that have both an on-site and online component will be implemented on a wide-scale basis. The increased use of computers across the curriculum will compel our students to be knowledgeable about computer ethics and the related social and legal issues so the rewards of technology can be reaped by all in an equitable manner. It is our pedagogical obligation to help learners develop the necessary habits of scholarship that are required for use of the computer, the Internet and electronic resources in an intellectually responsible way. Students of the 21st century will be responsible for their own learning and their learning will span more years of their lives than their counterparts in previous generations. The prediction is that university graduates will be life-long learners. Computers will be a part of the educational environment independent of the different learning styles of the students.

Students of all majors will be utilizing computers within the classroom, will be using computers as research tools, and will be using computers to communicate with friends and colleagues. For some, computers will actually serve as the sole vehicle to participate in classroom discussions. Computers will be an integral part of the professional, social and educational life of more and more people as the millennium unfolds. As such, in order to facilitate the appropriate use of the power of technology in student learning in the 21st century, we need to integrate the study of computer ethics into the different disciplines.

This document supports the contention that computer ethics should be integrated across the curriculum. One way of accomplishing this is to sponsor a faculty seminar day at one's institution. After a plenary session on the need for computer ethics given the percolation of technology through all aspects of education, smaller discipline related groups can meet to generate examples specifically geared to their curricula.

This paper provides a format for professors to generate their own assignments and examples. Assignments should represent ethical issues from areas such as fraud, freedom of speech, hacking/security, intellectual property rights, privacy and spamming, safety for critical systems, whistle-blowing, concerns of the workplace and critical thinking (Bowyer, 1999). We recommend that each class exercise or activity generated involve an independent search of the Net by students. This could, however, be done as a group, as a class, or if necessary, by the instructor with a handout provided to the students.

In our design of classroom exercises we address the following concerns:

- Topic area
- Target audience, the relevance to the course in which it is being used

- Materials
- Background information
- References
- Activity e.g. reading assignment, worksheet classroom exercise, debate (Bowyer, 1999)

In our paper session we present examples that cut across discipline lines, e.g. plagiarism and the appropriate citation of sources, as well as examples that are discipline specific. Due to the limitation of space, we will present only one example here.

The example we present has to do with whistle blowing. The setting is academia, but the underlying issues are applicable to the workplace environment as well.

Topic Area: Whistle Blowing

Target Audience: All students

Materials: A student handbook.

Background Discussion: The instructor should introduce the concept of whistle blowing in academia since it is a familiar environment. It should be pointed out that the ethical concerns involved in the case study are not limited to the university, but exist in the working world as well. The instructor needs to underscore that there is a level of risk to everyone involved in such a situation.

Activity: Collaborative Group-Work Worksheet and Class Discussion

The class should be divided into groups of students who evaluate the scenarios
on the worksheet. A discussion by the class as a whole should follow. The potential causes for whistle blowing in a distance learning environment should be presented. The instructor needs to emphasize that many people are affected by an unethical action and the reactions to it.

Worksheet:

Consider the following scenario and answer the questions that follow it.

A professor told her class that under no circumstances could students copy homework. You really think that a classmate has copied a corrected assignment and submitted it as though he had done it on his own.

1. What would you do?
2. If your first action did not produce the appropriate reaction from your point of view, what would you do next?
3. What would you do if you found out that you had made a mistake, i.e. your classmate had not really cheated?
4. What made you believe that your classmate was cheating?
5. What did you hope to accompish by blowing the whistle on your classmate?
6. Who are the people that may have gotten hurt by your action (Engel, Rundus and Turner, 1998)?
7.

We hope the presentation of some examples will generate dialog among pedagogical professionals to facilitate student learning in the 21st century. We encourage the instructor to develop his own example that embodies the ideas and principles in his course.

Students will be more responsible than ever for their own learning in the coming millennium. It is our pedagogical obligation to insure that the integration of technology will enhance the learning environment. The integration of computer ethics across the curriculum is critical because technology will be integrated into every aspect of a student's life and the 21st century learner will be a life-long learner.

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Virtual Teacher: Extension of Teacher Presence in a CLASS™ Independent Study High School Course

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Abstract: The Virtual Teacher study, implemented in four phases over two years, was a positive influence on the students in terms of hope and success expectation. Students were generally hopeful about their personal goals and life situations. Some aspects of the Virtual Teacher technology negatively impacted attribution, goals, and epistemologies. Innovation overload and technology refusal among at-risk youth bear further investigation. Focus groups allowed students to express how they experienced the online course. The classroom teacher reported fewer discipline problems, increased problem-solving skills, and increased patience in the class with the Virtual Teacher. The class without the Virtual Teacher continued to have students who encountered difficulty with minor problem solving.

Introduction

One of the challenges of distance learning is the distance between teacher and learner. This challenge is compounded in the independent study environment, where the learner is remotely located physically from the teacher, and not linked to a cohort of learners within a learning community. In an effort to bridge the teacher-learner distance, researchers with the University of Nebraska-Lincoln's CLASS™ project, Independent Study High School (ISHS), and the Center for Instructional Innovation (CII) designed the Virtual Teacher study to explore ways to extend teacher presence in the web-based, independent study learning environment.

Method

In the present case study, researchers sought to discover what messages a Virtual Teacher might use to affect learning outcomes. To do this, the study was designed and conducted in four phases, in collaboration with a local high school. The CLASS™ course chosen for the study was the Introduction to Technology course, a 9th grade introductory course, chosen because the course focus is on technology concepts, information literacy, problem solving, and critical thinking and is not a "technology training" course where students learn mastery over software.

There were four phases to this study. In the first three Phases, researchers worked with the students to create appropriate messages that the programmers could include in the Virtual Teacher program, and choose the message category to actually include with the Virtual Teacher.

Phase 4

During Phase 4, the ISHS teacher and the CLASS™ IDS again entered the high school to test the course and the Virtual Teacher. One classroom worked through the course section with the Virtual Teacher presence and the other classroom worked through the section without the Virtual Teacher. Effect on learning outcomes was measured through a comparison of unit test scores in both student groups. The teacher and students were interviewed in focus groups for their impressions of the experience.

Findings

4.2 Pretest and Posttest Attitudes about Learning Survey

There were 15 students in the Virtual Teacher class and 10 students in the non-Virtual Teacher class who completed both the Pretest and the Posttest. The Attitudes about Learning Survey consists of five sections: Success Expectations, Goal Orientations, Attributions—Locus of Control, Hope, and Epistemologies—Innate Ability. Each of the sections was analyzed for means.

Students who worked with the Virtual Teacher reported more increased **Success Expectations** while students without the Virtual Teacher reported more decreased success expectations. The Non Virtual Teacher class reported lower **Goal Orientation** scores in the Pretest. The **Attribution** section of the survey examines the source of the student's locus of control—internal vs. external. A lower score indicates the student holds an external locus of control and a higher score indicates the opposite. In the Virtual Teacher class, about one-fourth of the students increased their attribution scores, but three-fifths decreased their attribution scores after experiencing the Virtual Teacher program or the technology of the online course. Survey questions centering on **Hope** examined student attitudes about creative problem solving, meeting goals, and energy directed toward overcoming life's obstacles. Students were generally hopeful about their personal goals and life situations. The **Epistemologies** questions explored the student's personal understanding of the source of "smartness." The decline in the classroom with the Virtual Teacher program is slight, however the decline in the Non Virtual Teacher classroom is more noticeable.

4.3 Section Exam

The Section exam consisted of 25 questions totaling 50 points. The class with the Virtual Teacher program made fewer errors on the exam with a mean of 5.75 errors, mode of 8, and a range from 2 errors to 11 errors. In this range, the score of 11 is an outlier, with no students scoring a 10 or 9 and the remainder of the students scoring 8 or below. The standard deviation of the means is 2.517 for the Virtual Teacher class.

The class with the Non Virtual Teacher course section made more errors on the exam, with a mean of 7.31, mode of 6, and a range from 2 errors to 13 errors. In this range, distribution of scores was more even with the score of 2 being the outlier on the bottom end. The remaining scores were evenly distributed from 5 through 13, heavy at 6 (5 scores) and none at 12. The standard deviation of the means is 2.925 for the Non Virtual Teacher class.

	Virtual Teacher class	Non Virtual Teacher class
mean	5.75	7.31
mode	8 (4 times)	6 (5 times)
range	2 - 11	2 – 13
Sd	2.517	2.925

Table 1: Section Exam Statistics Comparison

Conclusion

The presence of the Virtual Teacher appears to have had a positive impact on attitude and learning outcomes for the students in this study. In the Virtual Teacher classroom, more students were successful with the test. In the Non Virtual Teacher classroom, more students had greater numbers of errors, representing less success with the test.

In addition, following the Virtual Teacher experience, the classroom teacher reported fewer discipline problems, increased problem-solving skills, and increased patience in the class with the Virtual Teacher. The class without the Virtual Teacher continued to have students who encountered difficulty with minor problem solving, and could not wait patiently until the teacher came to help with their question. There continues to be data to be analyzed, however these reports suggest the Virtual Teacher holds potential for extending teacher presence in the independent study learning setting.

Developing and Delivering Internet Based International Sections of a Common Course

Some Faculty/Student Considerations

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Abstract: What are some of the implications for course developers and faculty members when sections of a course are offered internationally in a virtual classroom over the Internet at different universities in different countries? To answer this question, a pilot project was completed during the summer semesters of 1999 between two universities, one in the United States and one in Germany. Based upon some very promising results, this pilot project was expanded during the summer semester 2000 to include multiple sections in the United States and four sections at three different universities in Germany. It was learned that faculty members make the course in the first instance; that students in sections with small faculty/student ratios were more satisfied with the course; and that faculty members welcomed the experience - but were burned out.

The Course

The course is a set of common courses taught simultaneously at different universities in the same virtual environment. Students complete the same assignments from a common syllabus and work together on joint projects over the Internet. However, this is not a single course, taught from one university and available to students from around the world over the Internet. In this course, students register for the course at their home university as they normally would, they complete the course under normal local expectations, and they receive credit at their home university. No costs or 'FTEs' are exchanged among the universities. Students from different countries and different universities share the same experiences in a virtual classroom and do so within their own academic structures.

The course is entitled: Internet Programming and has a prerequisite of two consecutive programming courses in the same language, or an equivalent background, in a current programming language such as Java or Visual Basic. It is divided into three parts. This first contains a quick review of basic HTML structures and the second an extensive introduction to DHTML, CSS and XML. The third part entails ASP pages and server-side computing, including database management. Students from different courses at different universities are assigned to the same project. Because the projects are challenging and because the results are posted over the Internet for the whole world to see, course expectations are high.

The numbers of students in the pilot project were small compared with those of the expanded project (a total of ca. 50 to ca. 200).

Student achievement mirrored that of in-class sections and students indicated that they found the material interesting and challenging. The students in the pilot project felt they received individual attention, enjoyed high interaction with the faculty and believed that faculty/student contact not only exceeded that of a normal course but also was one of the main reasons for their success. While also finding the material interesting and the course challenging, the students in the expanded project were not as satisfied with their faculty/student contact. They sometimes felt a lack of faculty availability even though agreeing that the class' web pages almost always contained an answer to their questions.

The increased number of students also increased the percent of those students that receive more attention than other students receive. No cultural differences were demonstrated among the students in working together on the projects. Systemic differences sometimes caused concern when students chose course options that were not available to all: for example, the ability to the leave the course without penalty after working as a member of a project team.

Results showed that students responded well to a student-oriented, well planned and delivered international Internet course – especially those with a smaller faculty/student ratio. With all other items being nearly equal, the issue of faculty/student interaction vs. numbers of students became a crucial element of success for some of the students.

Faculty Considerations

The instructor for the pilot project and the expanded project was an experienced faculty member with a history of successfully delivering web-based courses. The assignment for this project was considered a regular one-course assignment. There were no reductions in load and no special financial incentives. All scholarship expectations remained. The faculty member was expected to be supported with the usual technical advice and help with establishing student e-mail addresses, server folders, etc.

The faculty member found the pilot project interesting and greatly enjoyed the interaction with the students. This was reflected in student responses to the course. The pilot project was seen as a successful pedagogical experience even though it became a full-time assignment, rather than the effort of a single course. It was a new learning adventure and something valuable for future course planning and execution. The extra time was seen as a novel experience, well worth the effort.

However, the expanded project became extremely time consuming, especially when hardware failed, e-mail servers were not available, and students failed to follow directions or submitted assignments late. Increased numbers simply increased the number of those students with procedural, academic and personal problems. These numbers often became overwhelming. This resulted in a severe loss of productivity for the faculty member. By far the majority of time was spent on software, hardware and student related anomalies rather than on interacting with students who were doing well.

Since the faculty member was in the end responsible for all aspects of the project, there was no differentiation between what the faculty member was expected to contribute to the project and what aspects of the project should have been the responsibility of technicians and support staff. When servers were suddenly unavailable, the faculty member became the focal point of student attention, especially when assignments were due. Course evaluations addressed student and faculty successes, with the implication that success of the project is solely between these entities. (This was also true for the pilot project, but reaction and correction time was then much reduced with smaller numbers, leaving more time for students.)

The lack of experienced based parameters enabling faculty members to complete projects along with other obligations (other courses / service / scholarship) with a sense of success means that there is a need for pedagogically based studies on faculty members' roles in relation to their students in such courses. The ratio between faculty and students becomes very important for success. There is in this pilot project and the expanded project an indication that a faculty/student based international Internet (vs. correspondence) courses might well become more expensive than a standard in-house lecture course.

Development of a portal web site that integrates a collaborative learning environment and an e-commerce facility for small companies

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Abstract: This case study describes the evolution of a collaborative community of learners. It then illustrates how the ambitions and goals of the community developed and grew to embrace collaborative business ventures.

Initially the Creative Network was formed to facilitate Continuing Professional Development for the Creative Industries. Its aims were to provide both a face to face and a virtual environment to provide professional updates in new business and design technologies to artists, designers and any small company within a local region of England who provided creative services.

Following the successful development of a web site to support the learning community, new ways of adding value were considered. The members of the community wanted to explore the commercial potential of working together to quality assure services and provide more comprehensive services to clients.

The case study describes how members of the Creative Network formed clusters, to better serve the needs of their customers. The case study describes how the complementary skills of photographers, multimedia designers, exhibitions designers and business development consultants were integrated into more effective and comprehensive solutions for clients seeking value for money and efficient access to creative services through e-commerce.

The Background to the Development of the Creative Network Community

The Creative Network used a range of appropriate teaching and learning styles for mature learners. The members of the network wanted to sustain the community aspect of Creative Network so that it continued to provide additional flexibility for learning at a time and place to fit personal lifestyle and patterns of work.

It involved building a network of small companies where there was an atmosphere of trust and an ethic of collaboration. This was particularly difficult because of economic recession in some areas of England. Birmingham and the West Midlands went through dramatic changes during the 1970s and 1980's. The manufacturing companies that provided employment until the 1970s experienced difficulties. Many were not been able to survive global competition. Even now the region is still recovering from the collapse of a large portion of the traditional ceramics, engineering and automotive manufacturing sectors.

It is a region that is now beginning to re-invent itself, and create a new identity and economic base. Consequently the Creative Industries are seen as a growth sector to help regenerate the fortunes of the region. However even this new and vibrant sector faces the challenges of working in a global marketplace with dramatic change in business practices and new communications media.

Local creative companies were frustrated because their potential clients preferred to commission London based companies, but were rarely willing to consider the local creative service providers. The Community recognised that many creative people felt isolated within their own company and lacked the time and incentive to meet together with other professionals for training and business development activities. In particular many self-employed designers work long and very unpredictable hours, and therefore have limited opportunities to attend conventional training courses.

The Creative Network Community was therefore seen to have the potential to raise awareness about the ways in which local companies could compete with London on quality, originality and cost of creative services.

The Community provided members with the gateway to learning. It provided structured courses on HTML, web design, site management and database integration. It also provided a discussion area, including a range of threaded discussions initiated by individuals or special interest groups.

The Creative Network web site is a portal to global resources. By joining the network members can influence the content and structure of new courses that will bring real commercial benefits. In particular the feedback results in changes to the pace, structure and content of both the media for communication and the learning resources.

The Creative Network also has a social dimension, including regular conferences for members in addition to workshops at the University. This gives members the opportunity to actively influence the development of the learning community.

In particular the feedback from users resulted in changes to the pace, structure and content of both the media for communication and the learning resources. Unlike traditional approaches to learning offered by traditional UK Universities there was no standard course or assessment. Instead the tutors worked with each individual learner or company to analyse their development needs and structure a training plan and an e-commerce strategy.

The Development of Creative Business Solutions

The members of the Creative Network Community were keen to explore the commercial potential of e-commerce and to work together to encourage new potential customers for creative services, that the local West Midlands region of England had excellent creative skills and talents.

The idea of a portal to help members do electronic commerce was a radically new approach to collaboration and cost sharing. It evolved rapidly to accommodate the emerging needs of member companies. There were some initial psychological barriers to be overcome. Once it was appreciated that global e-commerce is "here to stay" and that 'the work will just move around the world to the most efficient and distinctive companies', then some of the initial objections to learning and sharing benefits and risks were reduced.

Many local micro-businesses (employing only 2 or 3 people) were surprised by the marketing presence that could be achieved by a well-designed web site with an e-commerce strategy. Some initial fears about sharing ideas and collaborating with similar small companies were overcome when it was appreciated that
"only one company can be the cheapest, and that the others must differentiate by good design"

The e-portal web site provides access to Creative Network Community and to Creative Business Solutions. The former focuses on the support that helps the members keep up to date with the latest design and business technologies. It includes links to specialised resources and global research information, on-line courses and discussion areas.

The Creative Business Solutions part of the web site is the new e-commerce portal . This has benefits both for new clients and the members of the Creative Network. The e-portal reduced the development costs of e-commerce to individual companies. It also creates a network for business to business communication. It also makes it easier to seek complementary partners with whom it is possible to deliver a seamless service to clients.

Creative Network e-portal

The Creative Network e-portal incorporates access to both a learning community and an e-commerce community. The e-portal continues to sustain a social dimension, including regular conferences for members in addition to workshops at the University. This gave members the opportunity to interact in a variety of ways to influence the development of the virtual community.

It is a cost effective e-commerce facility for members who collaborate by working in clusters to serve new clients. It also reduces the costs to clients who are appreciative of the efficiency savings in working with local companies who collaborate in a seamless way to customise a creative business solution to meet their needs.

Web-based and Traditional Instruction: A Systematic Study of student and Instructor Perceptions from a Graduate MLIS Program

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Abstract: The authors compared traditional classroom instruction with web-based equivalent courses in a graduate program in library and information science. The study investigated differences in overall student performance, student attitudes towards their courses and the learning approaches used. Findings indicate that there are no significant differences in student performance and that students felt the web-based experience worked well in certain environments.

Introduction

This study systematically compared the student learning outcomes and perceived effectiveness of several for-credit courses offered via the World Wide Web with traditional on-campus section of the same courses in the Master of Library and Information Science (MLIS) program at the University of Wisconsin-Milwaukee (UWM). The purpose of the study is to gain a greater understanding of the: appropriateness and effectiveness of web-based courses for graduate education; which technologies and approaches work best from both the students' and the instructors' perspectives; how students can best be prepared to participate in web-based classes; how faculty can best be encouraged and aided in developing and implementing such courses; and cost and time issues related to developing and delivering web-based courses.

There is a small but growing body of research at present comparing traditional and web-based education. Schrum (1998, p. 53), in describing the state of research surrounding web-based education, speaks to the need for comprehensive, in-depth evaluations such as the present study: "The impact of on-line courses has only begun to be investigated. To date, the traditional distance education literature has focused on the design and implementation of correspondence, compressed video, or satellite broadcast delivery courses. That literature provides some parallels, but does not directly inform the design and development of on-line courses." Findings of the present study have implications for the development of web-based courses in the graduate environment, as well as curricular redesign. A more complete overview and set of findings are available at: http://www.slis.uwm.edu/webstudy/index.html.

Methodology

Six courses in the MLIS program at UWM were selected for inclusion in the study. Each course was offered with a traditional onsite section and a web-based section. WebCT was used to mount the web-based courses and permitted synchronous and asynchronous communication between the instructor and the students. In all but one case, the courses were taught by the same instructor to control for differences between instructors in their presentation styles, pedagogical approaches, and course content. Students in each section of the course were surveyed at the beginning of the semester on their attitudes and perceptions towards educational technology, and specifically those technologies used in a web-based class. Students were surveyed again at the end of the semester on their educational experiences in the course. A pilot course was selected in the summer of 1999 to help refine the survey instruments. Attitudes and grade outcomes for each course were compared between the two sections for each course, and more generally across the traditional and web-based courses. Including the pilot course, total of 129 pairs of completed pre and post surveys by students in traditional sections and 53 in the web-based sections were received. A much lower response rate and generally smaller enrollments accounted for the lower number of responses in the web-based sections. Twelve students participated in in-depth follow-up telephone interviews regarding their experiences with web-based courses. Instructors for each of these courses were interviewed on their attitudes on teaching in a web-based environment. Those instructors new to web-based courses were given in-depth, qualitative pre and post interviews. In order to make sense of the qualitative data, coding procedures as described by Miles and Huberman

(1994) and Newman (1991) were utilized, allowing the researchers to assign units of meaning to the descriptive or inferential information compiled during a study.

Findings and Conclusions

Key findings for quantitative and qualitative measures are briefly reported here. T-tests were conducted comparing average final course grades between traditional and web-based sections of the same courses. Overall, there were no significant differences in four of six courses ($p > 0.05$). There were significant differences in two of the courses, in one case favoring the web-based course ($p < 0.005$), in the other the traditional classroom environment ($p < 0.028$). Students were asked in the post-questionnaire to rate the importance of different personal characteristics that students should bring with them to their respective instructional environments. T-tests reveal there were no significant differences in the importance of student flexibility, communication skills, and organization skills between the two environments. Students in the web-based sections, however, felt the attributes of self-discipline, self-motivation, technical expertise, and patience were more important in their environment than students in the traditional classroom environment. Students were also asked to rate the importance of characteristics an instructor for the course should bring to these environments. There were no significant differences between the environments regarding the importance of instructor subject knowledge, flexibility, patience, communication skill, and ability to facilitate discussions. Students in the traditional environment felt a dynamic presence was more important in their environment, while students in the web-based environment felt instructor knowledge of information technology and organization skills were more important.

The in-depth qualitative interviews with students and instructors were conducted in order to complement the quantitative findings. As Buchanan (1999) has discussed, qualitative research in web-based education is novel, and yet holds great potential for understanding and thus, increasing, the efficacy of web-based education. The qualitative findings are reported on the study web site and focus on student and instructor perceptions of: interactivity and control of dialogue, qualitative differences among student relationships, levels of preparedness and effort devoted to web-based education, attitudes and perceptions of types of delivery, and differences among distance education and traditional education students in terms of maturity, insight, abilities to communicate effectively, and real-world experiences.

The investigators are currently performing a finer-grained, in-depth analysis of the data, examining the influence of factors such as student demographics and the nature of the courses themselves, in addition to the specificity of the technology used and organizational approaches used by instructors. Instead of individuals learning to teach online as they are engaged in their courses, this research will offer pedagogically sound suggestions for efficacious web-based instruction. The mixed-method evaluative approach holds great potential for elucidating the positive and negative attributes of traditional and online delivery of graduate level coursework.

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Applying Technology to Science and Technology Literacy in the Classroom

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Abstract: The combined technologies of the Wold Wide Web ("the Web"), the Internet, and corporate/government/public intranets present the possibility of a new instructional paradigm. An approach for a software tool that organizes disparate on-line educational content into a coherent lesson is presented. Students of all ages who seek to improve their science/technology literacy with the reading and educational aids provided by this software will be able to do so using material that is both relevant and interesting. The software is also applicable to general literacy and education.

Introduction

Science-and-technology education has become a top priority in the United States and worldwide. Increased emphasis of science-and-technology curricula places additional pressure on overburdened teachers. The tools that instructors use must allow for the flexibility of selectable material especially within a technology curriculum where new advances are a daily occurrence and material relevance and application determine the lesson's success. Students should receive more than mere introductions; they need time and guidance for analyzing and researching instructor-identified material. Unfortunately, collecting pertinent information into a coherent lesson plan is challenging and time consuming. Information sources and formats vary and are rarely in a lesson-presentable state.

Approach

We are addressing the challenge of science and technology literacy in the classroom through the development of Internet browser extensions that provide teacher/student aids for finding, organizing, and understanding science-and-technology-related material. The *Science and Technology Literacy (STL) Desktop* provides a variety of aids to science and technology students while also providing a simple means for the inclusion of new reading material and new on-line resources (e.g., on-line dictionaries). A fundamental goal of this work is to provide a tool that is applicable to new Web-based and not tied to vendor-provided classroom material. This allows the instructor to select the material used for instruction and to integrate the material into a lesson plan. The lesson plans can be tuned to student abilities and can constantly challenge their skill-level while maintaining interest and reducing instructor workload.

Given the amount of science-and-technology information that is being placed on the Web, our approach is to apply the latest technologies in accessing and analyzing on-line information to the problems encountered by instructors in collecting and filtering information into a lesson. Our implementation approach is to rapidly develop a series of *STL Desktop* prototypes that incorporate the latest technological advances and test new concepts for viability. This allows a quick determination those technologies that are immediately feasible technologies and those that are not sufficiently mature for insertion but may be in the future.

We have been investigating technologies from Java-based browser development, speech understanding, pattern recognition and manipulation, ontologies, readability formulas, machine understanding of text and concepts, and artificial-intelligence-based text generation. The result of our endeavors is a collection of instructional aids with planned extensions into an integrated, intelligent, pedagogical assistant. The current *STL Desktop* prototype demonstrates the potential usefulness of our vision. The planned *STL Desktop* will be a fully functional Internet browsing tool that contains the following science and technology instructional aids:

- *STL Browser*: A standard Web browser with extensions that provide quick look-up of words to pre-identified reference materials.
    - Single-click reference of scientific (and general) word definition,

  - Auto-creation of hyperlinks from the browsed document to science and technology reference material sites;
- *STL Lesson Editor*: A tool that aids in the creation of on-line lessons that consist of on-line documents (e.g., Web pages) which are automatically enhanced with additional hyperlinks to on-line reference material.
  - Simple drag-and-drop interface for creating lessons.
  - Functionality integrated with *STL Browser* for more convenient lesson generation.
- *STL Activity Generator*: (under development) This tool will automatically generate reinforcement activities and test questions from the browsed material.
  - Automatically generates and scores activities/quizzes covering the material currently being viewed;
  - Teacher-guided automatic creation of higher-level thinking activities composed from identified material;
- *STL Class Manager*: (under development) Contains methods for tracking student activity and progress.
  - Keeps track of all students progress in using the *STL Desktop*.
- *STL Readability Package*: (under development) This will provide new uses of readability research in document filtration and recommendation.
  - Document screening for reading difficulty and matching to student skill levels;
  - Automatic estimation of student reading skills level based on observed browser usage;
- *STL Speech Package* : Use of off-the-shelf speech package to provide
  - Word pronunciation/vocalization and passage narration with speech synthesis;
  - Student pronunciation/narration monitoring via speech recognition;

The usage of the core functionality of the *STL Desktop* is split into two halves; the instructor half and the student half. The instructor first interacts with the *STL Lesson Editor* component of the *STL Desktop* in identifying various reference materials (including CD-ROM based materials, Internet sites, and other on-line information sources), and is walked through a series of simplified questions and options pertaining to: the Internet pages that compose the lesson; instructions associated with the lesson and with each page; identified resources and references; and activities or quiz questions (that are automatically generated and presented to the teacher for review). At this point the lesson is defined and registered into the teacher's "lessons area." Students can access and navigate the lessons through the *STL Browser* windows. The resources/references identified by the teacher are contained within the indexing scheme of the *STL Desktop*. To find information about a word encountered on a Web page, the student needs only select the word from the browsed document, and identify the type of information desired. The automatic hyper-link generation will have already cross-referenced the word with the reference material, and the desired information can be accessed across the Web and displayed for the student.

The benefit of the *STL Desktop* is the easy access to auxiliary Web-based reference information that results in an enhanced learning experience. This approach is also applicable to general browsing where there is no defined lesson, but identified references are automatically hyper-linked into Web pages that are being viewed. The hyper-linking does not alter the original document, nor does it interfere with any other hypertext already resident in the document.

Conclusions

We presented the concept of the *Science and Technology Literacy Desktop* that provides both student and teacher with the capabilities to find, organize, and understand science and technology related material on the Web. This ongoing research and development effort is attempting to apply new technology to the problem of science and technology literacy in our classrooms. The results of this effort should be applicable beyond science and technology literacy, finding use within other focus areas of education and training, as well as general literacy, education, English as a second language (ESL), and even as a general browsing aid.

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Advantages and Disadvantages of the Electronic Portfolio: Issues for College Administrators

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Introduction

Assessment reform is a cutting-edge education policy issue. College administrators must address technical quality, credibility with constituencies, and feasibility in use of new assessment tools (Creating Better Student Assessments 00). A portfolio is "a purposeful collection of student work that exhibits...efforts, progress, or achievement" (Suen 96). It may contain writing samples, project summaries, and progress assessments (French 92). It must indicate content selection and evaluative criteria (Suen 96). Electronic portfolios are useful assessment reform tools, affording advantages for assessing traditional or online learning.

Advantages of the Electronic Portfolio

Curricular and Administrative Issues

Using e-portfolios requires aligning curriculum with instructional strategies (French 92). Teaching objectives and methods must empower students to produce work worth including in e-portfolios. E-portfolios' contents also provide longitudinal evidence of curricular change (French 92).

Various constituencies hold college administrators accountable for educational outcomes. Colleges may add e-portfolios to admissions requirements to assure that students possess requisite knowledge and skills, and may require them as proof of completion of degree requirements or Latin honors qualification (Lankes 95).

The characteristics of online programs render many assessment techniques obsolete (Carlson & Burk 98). E-portfolios provide indicators of online learning success, including evidence of class participation via threaded discussions and summaries of collaborative solutions to complex problems (Carlson & Burk 98).

Faculty and Financial Issues

As e-portfolios become common, faculty from various disciplines will share best practices, improving their pedagogical value (Student Portfolios: Administrative Uses 93). Entrepreneurs and educators are pioneering websites for training faculty to use e-portfolios (Neill 00). Because they use zip-disks or CD-ROMs, e-portfolios provide efficient records maintenance (Herman 99).

College administrators are accountable for financial outcomes. Taxpayers, parents, students, and alumni demand proof of efficient resource use. E-portfolios can maximize results and minimize costs. Regional educational consortia are developing assessment criteria and tools, including e-portfolios. Participation in these consortia allows colleges to adopt assessment tools at minimal cost (French 92).

Disadvantages of the Electronic Portfolio

The disadvantages of e-portfolios are minimal compared to the advantages. If college administrators fail to promulgate their objectives for using e-portfolios, the result will be flawed or non-comparable data (Student Portfolios: Administrative Uses 93). Faculty must be trained to use e-portfolios correctly, establishing appropriate benchmarks for student progress and using them consistently across e-portfolios (French 92).

Sometimes faculty resistance to change can be enormous, especially at colleges where entrenched, senior, traditionally grounded, and/or technologically challenged faculty predominate (Carlson & Burk 98). The college administrators' challenge is to convince resistant faculty that the pedagogical advantages of e-portfolios compensate for their intellectual, emotional, and chronological investment.

Conclusion

E-portfolios allow college administrators to solve continuing curricular, faculty, and financial issues. In assessment, e-portfolios help to align curriculum, instructional strategies, and assessment activities as colleges offer online programs. Their use encourages faculty collaboration and cross-fertilization. E-portfolios also afford administrators the opportunity to enhance their curricula with financial efficiency, delighting the constituencies which hold them accountable for educational and fiduciary outcomes. The disadvantages it presents are far from insurmountable, and may become moot with the passage of time and the paradigm shift to more active learning.

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Application for An Architecture to Coordinate Multi-Agent Systems

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Abstract

Coordination is the process that manages the interdependencies in to the activities. Communications are based in the detection and response to coordination relations between tasks sets that are known by some agents. Coordination discute how agents can generate communication tasks which help the coordination process, how the agents can thrust in the inferences from receivers to carry out their tasks and, how the agents are in favor to plans and communications to carry out concurrent executions using PGP and GPGP. PGPG and GPGP are sets of coordination mechanisms, independent-domain that use constraints to split a local planner in modules. These constraints give importance to some tasks due they help to no-local tasks can be done and their beginning and ending time can be good.

In this article, we use Yubarta framework referenced in (Ucros, 1996) to carry out the coordination process for the distribution of the information in an organization that flows between Auditory department and Systems department areas. This process avoid loss, delay or replication of the information. Coordination process was done in two levels : the first level talks about the agents which involve the system and, the second level talks about the task that each agent carries out. For these levels we use Template Mediator, an hierarchical architecture to coordinate agents that is used to distribute task for each agent and to verify the results of themselves.

System Auditing

System Auditing consists of evaluating the information internal control system of those that are working. As the auditable object, the data porcessing loop (system where the data to be protected flows) is taken. Lately an operational view has been taken for this field, applying parameters such as low costs, efficiency and effectiveness; this auditing is carried out by testing and evaluating the administrative process applied to computers, where the systematized areas are part of the auditable object and of the whole computers area with the organization components, in general, always keeping in mind the objectives and mission of the organization.

Conclusions

- The administrative process requires a strong coordination work, because of the information management between different stages and to check on the way the tasks are carried out on each one of them.

- The coordination process of an organizational task (such as auditing) is very complex. The task not only has to be seen as a whole, but the processes that have to be carried out inside have to be considered too. It is important to mention that in order to make easier the coordination task, it is better to carry it out at different levels, as explained on this paper.

- To model information management in the auditing administrative process, the YUBARTA model was chosen because the coordination task that is done among the agents, allows them to consider all the task to distribute them coherently according to time, costs, dynamic environment and other constraints. Also, such process allows execution coordination to: avoid work replication, avoid work overloaded agents and make agent's subplans compatible. The administrative process architecture is a hierarchy like the Template Mediator, because it fits very well in the process definition and the coordination model better described in (Carrillo 1998).

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PROSPECTUS FOR AN ON-LINE "INTRODUCTION TO ASSISTIVE TECHNOLOGY" COURSE

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Abstract: This paper describes the development a course that would present the basic concepts and applications of assistive technology (AT). The AT course is designed as an introductory course in the application of technology as assistive and adaptive devices and could be applied as an elective course for the current programs in education, instructional technology, or exceptional education programs. The course presents strategies for students who are physically or mentally impaired, and may be in a mainstreamed situation. The purpose of the course material is to learn about and use technologies to overcome handicaps and improve functionality. The Introduction to Assistive Technology course stresses hands-on experiences with various assistive technology approaches and devices.

Identifying the needs, the gap and the goals

Through the direction of the federal government, assistive technology (AT) must now be addressed on every Individualized Education Plan (IEP) and the assistive technology can be a component of exceptional education or a service to facilitate a student's education (IDEA, P.L. 101-476). Institutions of higher education offering preservice teacher education need to meet the International Society for Technology in Education (ISTE) (and therefore the National Counsel for Accreditation of Teacher Education [NCATE]) standards. The offering of training and education in assistive technology has become even more important. Not only do exceptional education instructors need this information, but so too do school administrators and the general education teacher. All teachers now need to be aware of strategies and tools for the special needs student, due to the movement to provide the least restrictive environment through mainstreaming and inclusion.

During discussions with inservice teachers, counselors, physical therapists, parents, and assistive technology organizations, I identified a need for training and education in the area of assistive technologies. Through continuing discussions, I identified some basic areas needed in assistive technology education. I visited the Assistive Technology Educational Network (ATEN), Florida Diagnostic Learning Resources (FDLRS) and Florida Instructional Materials (FIMSE) labs and workshops to learn what the state of the art was and become a part of the AT community. I continued my exploration by surveying the literature in the field, observing at schools and labs, and studying current Exceptional Student Education (ESE) and Instructional Technology (IT) programs offered at my university. To begin to fill the need that I perceived, I developed and co-taught a daylong hands-on workshop introducing teachers to assistive technology.

To provide more extensive experience and education to teachers, I developed a course that would present the basic concepts and applications of assistive technology. The course is designed as an effective elective course for the current programs that the university offers in its master's of education, instructional technology, or exceptional education programs. The NCATE/ISTE standards state that for initial certification, a teacher should "demonstrate awareness for resources for adaptive assistive devices for students with special needs."

Course development

The AT course is designed as an introductory survey course in the application of technology as assistive and adaptive devices. The course presents strategies for students who are physically or mentally impaired, and may be in a mainstreamed situation. The purpose of the course material is to learn about and use technologies to overcome handicaps and improve functionality. Course topics include: Introduction to assistive technology; Legal/ethical issues and the IEP; High tech, mid tech, low tech, toys, switches and other adaptations; Windows & Mac built-in accessibility tools; Text-to-speech, speech-to-text, and the internet; Mobility and physical impairments; Hearing and vision impairments; and Learning disabilities.

The assessments and activities for the course include hands-on experiences with assistive technologies. Activities were designed in which students visit schools or labs to see assistive technology being used, they apply and use text-to-speech and speech-to-text programs, they construct adaptive switches and toys, and they even experiment with environmental control hardware and software.

I asked members of parent support organizations such as the Statewide Advocacy Network on Disabilities (STAND), university professionals in special education, assistive technology state organizations such as Florida Diagnostic and Learning Resources System (FDLRS) and Assistive Technology Education Network (ATEN), future students in exceptional education, and other instructional technology professionals to provide feedback on the course design, goals, topics and assessments. All were extremely pleased with the idea of the material becoming available for ESE and general education educators.

In continuing discussions with the assistive technology community, I chose to design the course for delivery through distance learning. I found many prospective students who are interested in the course concept, but were unable to travel to the university. The course will be a valuable recertification course for ESE professionals and teachers who not specifically in the special education field. This course will allow them to have some exposure to the implementation of assistive technology. The AT course can be used in any certification area, since in the state of Florida technology is considered in field for all areas. The course itself should model effective design practices, for example web pages will be designed for universal access and course materials and multimedia will be developed to be handicapped accessible. Through online delivery, the course can serve as a model presentation of information through an adaptive medium. The online format of the course will fit easily into the schedules of working adults across the state and beyond.

Learning Strategies

The Introduction to Assistive Technology course stresses hands-on experiences with various assistive technology approaches and devices. Designing methods for a student to have actual experiences with the technology going beyond readings and looking at images about the technology is one of the main course goals. Instead of purchasing texts, students are expected to purchase, train, and use voice input systems, install an use an environmental controls system, purchase the materials to construct an adaptive switch, purchase and use a voice repeater, and use speaking hardware devices. Student interactions with assistive technologies fall into three areas. Students are to interact in an online forum, they have field experiences, and complete technology projects, in addition to standard materials such as tests and papers.

One of the strategies used in the Introduction to Assistive Technology course is the forum. Students participate for themselves and also analyze what other students have done and provide feedback to their classmates' thoughts. Forum topics include case studies that students use in experimenting with, suggesting and explaining assistive technologies. Other forums require students to make decisions concerning the use of assistive technology for others. Further forum topics encourage students to discuss and evaluate the impact that the assistive technologies have on them while they use various devices and programs such as environmental control, voice input, and text-to-speech.

Students will be required to observe the use of assistive technology as part of their field experiences. Students are asked to observe a student who uses assistive technology devices, or investigate and visit an assistive technology demonstration lab. Using an assistive technology device checklist and observation form, they would observe how the technologies are being used and then contribute to an online exchange concerning their observations.

Currently seven projects are being designed to give students additional experiences with assistive technology in evaluation, adaptation, and creation of assistive technology devices. Students evaluate web sites for universal access, compare various assistive technology software products, compare assistive technology hardware tools, and even complete an evaluation of a student related to the use of a specific assistive technology. Students are to use software to create a communication board that augments communication within a specific class or function. Additionally students construct an impaired accessible switch and then adapt a child's toy to be switch operated.

At this point in time, the course is in the final stages of design for online delivery. The current on-line delivery package for the course is the university's WebCT package. WebCT was selected because of its privacy, testing, and forum components. Additional support is being sought for the creation of a supplemental traveling assistive technology box. Sent through the standard mail system, this box would provide students access to the more expensive technologies including touch screens, alternative keyboard inputs, talk boxes, close captioning devices, and more.

SHARING IT STAFF DEVELOPMENT THROUGH A STATEWIDE WEB RESOURCE

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Abstract: In the state of Florida, a web database has been developed to keep school districts and other agencies updated about available resources for staff development in instructional technology. This paper provides an overview of the need for the database, and its development and deployment. Florida Council of Instructional Technology Leaders (FCITL) developed a centralized statewide technology training resource database. The database is a repository of resources contributed by districts to share with the goal of improving the teaching skills of all Florida educators, and ultimately impacting the learning of all children.

In all organizations, communication regarding new and existing resources is important. In instructional technology, it is especially important for communication to be regular, efficient and rapid. In the state of Florida, a web database has been developed to keep school districts and other agencies updated about available resources for staff development in instructional technology. This paper provides an overview of the need for the database, and its development and deployment.

Public education in the state of Florida occurs under county school district control with each district following state mandated procedures. The state provides annual school technology funding and sets requirements and restrictions for the expenditure of the funds. Additional school technology funds are available in the form of competitive grants to districts or consortia. Recently, the state has added a requirement that a specific proportion of the funds go directly toward educator staff development in technology. The state also allows teachers in any certification area to recertify by earning technology inservice training credits. To assist districts in meeting their technology training needs, the state supports three instructional technology centers and a network of centers for educational enhancement where workshops, materials, and other resources are available to districts upon request.

Each school district has developed its own technology plans and goals. Needless to say, districts now fall along a wide continuum of progress regarding equipment, infrastructure, and staff expertise. While some districts have very modern equipment and connectivity in each classroom, others struggle to place Internet-connected computers in every school. Similarly, some districts enjoy a deep pool of highly skilled technology-using teachers, while others are working to provide entry-level skills to staff. Even within a single district, it is difficult for a small technology staff to meet the needs of all teachers. In addition to these inequities, Florida is a large socially and geographically diverse state, in which the two most distant districts are almost 800 miles apart by road. Physically meeting to share resources among district technology leaders is a costly and time-intensive endeavor.

The need for technology staff development and the discrepancies among districts have been recognized by the organization of district technology leaders, the Florida Council of Instructional Technology Leaders (FCITL). The Council's members meet semiannually to share approaches and quality materials that have been developed by districts. At the Fall 1999 FCITL meeting, the idea of a centralized statewide technology training resource database was proposed. The database would be a repository of resources contributed by districts to share with the goal of improving the teaching skills of all Florida educators, and ultimately impacting the learning of all children. The FCITL resource database would reduce repetitive efforts and unnecessary spending of districts because they would quickly learn whether a needed tool had already been created elsewhere. The database would lead to equity for the districts in greatest need of technology training support, and bring recognition to the districts where exemplary materials had been developed. In addition, state grants require districts to disseminate materials developed as part of the grant project. When the grant supports technology staff development, the grant requirements would be fulfilled when items were submitted to the database.

In the Fall of 1999, the president of FCITL described the vision for the state resource database. The FCITL database would be a searchable web page where visitors could quickly locate technology staff development materials. District representatives strongly supported the effort. Forms were distributed to request resources from each district, district technology leaders submitted dozens of resources immediately. For the technical tasks of building the web database, the FCITL president approached the Florida Center for Instructional Technology (FCIT). FCIT is one of the state's three instructional technology centers. FCIT agreed to develop and host the web database. During the winter of 2000, FCIT staff received the resource forms submitted by the districts, and began planning the database. The goal was to unveil the result at the February meeting of FCITL that takes place at the state educational technology conference.

Development of the Florida Educational Technology Training Resource Database began with several technical decisions. The web environment and database container for the resources were chosen. Comparisons were made between Microsoft FoxPro, FileMaker Pro, and Microsoft Access as possible databases. FCIT staff and programmers had experience developing searchable web databases with each product, and none of the products would require additional hardware or software purchases. For serving the database over the web, Microsoft FrontPage, FileMaker Pro, and Allaire Cold Fusion were evaluated. In each case, FCIT possessed the knowledge and infrastructure to use the products. The decision to use a MS Access database with Cold Fusion web templates was based on the flexibility of the products and development support provided with each product.

The Access database was created to contain the district resources described on paper. Because all districts were not represented at the meeting where the forms were submitted, FCIT conducted a survey of districts in order to locate additional resources. First, the web sites of each district were searched for technology training resources that may be useful statewide. Next, each district technology coordinator with an available email address was sent a request asking for permission to use resources located on district web sites. Coordinators were also given an opportunity to send additional resources from the district. Resources were submitted in the form of URLs linking to materials at district web sites, and as document files to be housed directly in the FCITL database. Almost 60 resources were identified by February, including tutorials, manuals, web and software evaluations and reviews, lesson plans, troubleshooting guides, curriculum integration information, and workshop materials.

As materials were compiled into the database, dynamically querying web templates were created using Cold Fusion Studio. Adobe Photoshop was used to develop original graphics. A Cold Fusion server was setup to host the templates, graphics and the database. The Cold Fusion templates were designed to display database search forms and then to deliver search results. Users may search the database by district, by keyword or by resource type. The district search is facilitated by a dynamically created drop-down box listing all districts and agencies represented in the database. Keyword search queries a keyword field containing descriptive terms for each database entry. Resource types, such as tutorial, lesson plan and others, are selected using radio buttons. After options are selected, and the Search button is clicked, the query is sent to the Cold Fusion server, and the results are listed in a new printable page. Each result includes the resource name, contributing district, district home page URL, resource description, and link to the resource web page or downloadable file.

The finished database was previewed by FCITL members at their February meeting, then districts and FCITL members were notified via mailing list and electronic newsletter of the release of the web site. As districts realized the importance and usefulness of the database, they continued to submit resources to the database manager via email.

The Florida Educational Technology Training Resource Database has become a time and money optimizing tool for school districts across Florida. It is used by staff development trainers in search of materials and strategies for their workshops. It is used by educators who seek troubleshooting assistance and knowledge in instructional technology. It is also used by district technology leaders who need examples of approaches taken by others in meeting the changing staff development needs of teachers. Even college and university education professors in instructional technology use the database to teach their students about conditions and needs in schools. As the database grows, it will become an increasingly powerful tool to enable teachers and students to better enhance learning with technology.

ONLINE DISCUSSION FORUM FOR PRESERVICE EDUCATOR ARTICULATION

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Abstract: This paper presents an overview of the online forum component of two on campus undergraduate education methods courses. The following description outlines the benefits students received because of participating in the forum, and the strategies used to make the forum successful. The online forum discussed here was used in an Elementary Science Methods course and a Secondary Science Methods course. While the courses met regularly on campus on separate evenings, a single unified forum group was established for where all students interacted. All students were required to participate regularly in the forum discussions throughout the semester. Participation in the forum accomplished three learning goals: students were exposed to a perspective from another education level, they gained experience with the Florida Educator Accomplished Practices, and they expressed their opinions about important science education issues.

Today, pre-service teachers need experiences in modern communications technologies and their effective use in instruction. This need applies not only for distance education students but also for in-class students. The benefits of distance education experiences for undergraduate education students are many. When integrated into a traditional undergraduate course, distance education greatly extends classroom learning. This paper presents an overview of the online forum component of two on campus undergraduate education methods courses. The online forum in this case was unique for two reasons: the forum connected groups of students from elementary and secondary education, and the forum provided for extended interaction about the state's twelve educator "Accomplished Practices." The following description outlines the benefits students received because of participating in the forum, and the strategies used to make the forum successful.

The instructors attempted to include an online forum topic for each of the Florida Department of Education Accomplished Practices: Assessment, Communication, Continuous Improvement, Critical Thinking, Diversity, Ethics, Human Development and Learning, Knowledge of Subject Matter, Learning Environments, Planning, Role of the Teacher, Technology. The Accomplished Practices are listed here, followed by the correlated forum topics and a sample student response. The entire semester-long forum was composed of 384 entries made by the two instructors and 45 students. Approximately half of the students represented elementary and half came from secondary education programs.

The undergraduate Science Methods students received many benefits from the online forum.

1. Individualization of learning:

The forum allowed for more individualized learning than was possible in the classroom alone. Students added their personal responses to forum topics, without limits on time or the length of responses.

2. Encouragement of critical thinking

Forum questions were open-ended and designed to encourage students to take a position on the issues. To respond to a forum topic required organized thought and synthesis of concepts introduced in class.

3. Student autonomy

The forum assignment required students to respond to each topic during the semester. Many students stated that they routinely discussed the forum topics with friends, family and colleagues outside of class before putting their comments online.

4. Increased interaction time

A 45-hour semester places severe limits on the quality of discussions and experiences possible in a course. The elementary science methods course is the only science methods course required in the elementary education program. In a three-hour class meeting, an equal division of time allots only 5 minutes of discussion per student. Regular forum discussion adds hours of interaction over a semester.

5. More democratic exchange

In any class of 25-30 students, there will be dominant personalities and students who may feel intimidated or unmotivated to speak. In the online forum, each student has a voice that will be heard by anyone who chooses to read his or her comments.

6. More time to formulate responses and opinions

Because the forum discussions occurred completely online, students had the flexibility to add their input when they were prepared. Preservice students in the classes were much more comfortable discussing topics online after reading the viewpoints of the more experienced students.

7. Flexibility and convenience

Students set their own schedule for the forum. The forum was available at all times of day or night to accommodate school, work, and family demands. The forum was accessible from any Internet connection via the World Wide Web, allowing students to participate even when they were sick or traveling.

One of the great strengths of the online science education forum was the connection it gave to the students studying to teach at different levels. In a College of Education as large as the University of South Florida, there tends to be little mixing of students in the elementary and secondary education programs. Professors work to include information in their classes about K-12 levels, but it is sustained personal interaction with others that best contributes to an understanding of education at all levels. While the course forum focused only on science education, it offered a unique opportunity for students to develop a relationship with current and future teachers outside their own specialization.

Articulation benefits:

1. Students learn about the content from another perspective.

Elementary education majors found an accessible resource in the secondary science education majors. Before this course, many of the elementary students got science information from the media or science instructors. Because of the forum, they communicated comfortably with peers who had strong interest and ability in science. At the same time, the secondary students gained insight into science understanding when they read and responded to the elementary students' questions and comments.

2. Students learn about children's concepts of the content at the other level.

Students at both levels shared strategies for teaching science concepts at their respective levels. They all learned more about child development across the range of ages.

3. Students appreciate where the children have been/are going.

The forum refocused the students' attention on what can be expected of children at elementary through secondary school. The elementary students have an appreciation of the importance of a solid foundation in science at grades K-6, and the secondary students recognize the skills that are developed in K-6 curriculum.

4. Students appreciate the concerns and conditions in schooling at the other level.

The elementary students have witnessed firsthand through the forum how a child's excitement about science can build into an important career. They communicated with a group of preservice and inservice teachers who wrote very passionately about the importance of science. The secondary students now understand the integrated nature of K-8 curriculum, and the often-competing demands on a K-6 grade teacher to address all content areas in a self-contained classroom with limited materials.

5. Students experience a professional communication process.

All of the forum participants have experienced personal and academic gains as result of their communication with their peers.

6. Students communicate about science across disciplines.

Students at both levels wrote about a variety of science areas without concentrating on their specialization area, favorite area, or strongest area.

7. Elementary students find a content resource.

Elementary teachers have limited contact with content area experts. The forum introduced the elementary students to teachers who could serve as content resources during the methods course, through student teaching, and into school employment.

During the semester in which the science education students participated in the online forum, they expressed a range of reactions. Some students had initial difficulty accessing the forum and adding responses. Once the students became familiar with the forum structure, they participated regularly and enthusiastically. In the final course evaluations, technology was singled out repeatedly as a highlight of the course. One student stated that the forum was one of the strengths of the class.

Designing an Asynchronous/Synchronous Combination Distance Learning Environment based on Web-BBS

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Abstract: This paper proposes a new distance education architecture to integrate both BBS and WWW features, is so-called IVC (Internet Virtual Classroom). This architecture has not only the traditional asynchronous characteristics of learning systems on WWW, but also synchronous interactions that traditional BBS service owned. This sort of learning environment can record and the learning flows of learners and analyze those collected data after a period time.

keywords: *Distance Learning, WWW, Client-Server, Synchronous, BBS.*

1. Distance Learning and Internet Virtual Classroom

This paper proposes an architecture that integrates not only both advantages of synchronous learning and asynchronous learning, but also several teaching and learning technologies, such as learning assistant, flow control, and evaluation model of problem solving *etc.* [CCH99][HHCH99][KHCH99]

2. System Modules of Internet Virtual Classroom

In this section, the components and characteristics of IVC will be analyzed. IVC has the synchronous learning and asynchronous model.

A. **System Administration:** group identification, flow control and data collection.
B. **Students' Support in IVC:** discussion, observation, competition learning, group learning, repeat learning and learning log collection.
C. **Teachers' Support in IVC:** design the teaching material, design the examination paper, plan learning path, answer learners' questions, analyze learners' learning behaviors.

3. IVC System Design

In this section, we will discuss the architecture of IVC. Each component must meet the requirements that has analyzed in the previous section.

A. **Client Layer:** multi-language support, users' identification, and web management console (includes web page management tools and teaching management tools).
B. **Server Layer:** three servers in IVC, including BBS server, Web server and Database server.
C. **System inner transactions:** four transactions existed in IVC, including IVC kernel and BBS, IVC kernel and Virtual Lab, IVC kernel and Data Center, IVC kernel and Agent.

4. Experiment System and Conclusions

An IVC experiment system is also implemented, named **IVC 21 Century** (http://ivc.cycu.edu.tw), which contains Department Office, Teaching Building, Science Experiment Center, Data Center and Conference Hall.

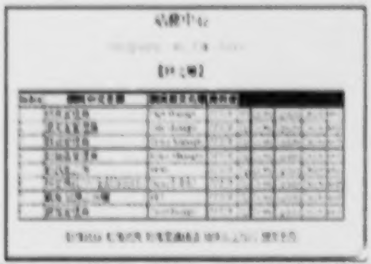

Figure 1. Web page manager tool in IVC

Figure 2. Flow control in IVC

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Web Database and Its Applications in Teaching Database

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Abstract: The paper considers the issues of Web database technology and its application in teaching database classes. It discusses the usefulness of Web databases in business and in teaching. The discussion on the implementation of a Web database with Java programming language is also given. The ease of learning Java, its reliability, and its portability make this programming language a convenient tool to implement a Web database. As an assistant in classroom teaching, Web databases have the flexibility needed to develop classroom demonstrations and Internet enabled client-server applications. The objective of this paper is to discuss the implementation of Web databases in classroom teaching.

1. Web Database Technique

As the e-commerce has been adopted by more and more companies, the Web database technology becomes a key component to the business to business communication. The Web databases are used to publish business information, to sell products over the Internet, to perform online stock trading, and so on. Database applications such as online forms and online reports are created to operate daily business activities. Customers can place their orders through the Internet. The order information is kept in a Web database. Customers can also query the product information stored in a Web database through Internet. Data transmission over the Internet is a two-way transmission.

For a company with thousands of customers, the Web database technology uses a three-tier architecture. SQL statements, relational data, and client-server information are transmitted through the interfaces among the clients, Web server, and database server. The client tier may include PC's with various platforms. Through a browser, a client can query the information stored in a database which is placed on the database server tier. On the client tier, a graphical user interface is provided for users to enter data or retrieve information. Usually, the Web server is installed on the middle tier. The Web server is used to accomplish three tasks. The first task is to receive requests from clients and generate response. The second task is to run the scripting languages, such as the VBScript and JavaScript, which are used to implement the business logic. The third task is to create, edit, and run the database views. The commonly used Web servers are Microsoft IIS with a Microsoft NT server and the Oracle Application server. The DBMS and the data files are installed on the database server tier. The database server is used to run the DBMS, which can be used to process SQL statements. The purpose of a database server is to supply data to tables or applications such as forms and reports on the client side. For large companies, the commonly used DBMS's are ORACLE, IBM DB2, and Informix. Usually, these DBMS's are running with a UNIX operating system.

To process data transmission over the Internet, Internet capable programming languages can be used to program online activities. An example of these languages is Java which is a platform free, fully object-oriented programming language and can be used to process database activities on both client and database server sides. Some scripting languages such as JavaScript and VBScript can be used to build and communicate SQL requests to the DBMS and perform data validation. Some Markup Languages such as DHTML and XML can be used to specify the appearance and behavior of a Web page.

As the Web database technology becomes a more and more important part of database processing, some text books start to introduce the technology. To improve teaching and learning, a faculty member can develop projects to demonstrate the Web database concepts and to let students experiment with the Web database to gain hands-on experience.

2. Using Web Database Projects to Assist Teaching

Database development is one of the key courses in a computer science or information systems curriculum. Connecting to databases from the World Wide Web enhances teaching and learning. Students will be able to develop, modify, discuss, and submit database projects over the Internet. With the Java interface, the Web-based database projects allow interactivity by providing a graphical user interface. Through the graphical user interface, students can test their SQL queries, add and delete records in a database table, and search for specific records in a database. By using the Web database, students are able to develop applications such as online shopping systems, online registration and discussion, tracking stocks online, and many other Internet applications.

In the recent version of Java programming language, JDK1.2.1, the package *java.sql* contains classes and interfaces to handle database activities. To connect to a remote database through the Internet, interface *Connection* is used to process the connection between the graphical user interface programed by Java and the database. The database connection requires the URL of the database, which specifies the protocol for communication. In some cases, the username and password may also be required to log on for database security. Once the database URL is passed into the method *getConnection()* in the class *DriverManager*, the connection is established by the method. A query to the database is placed in the *Statement* object which is used to submit the SQL statement. The method executeQuery() in the *Statement* object returns the result of a query from a database loaded on the database server tier and places the result in a *ResultSet* object. The method *getMetaData()* in a *ResultSet* object returns the metadata which contains information about the column or table structures in a database. The metadata information such as the name and type of a column can be used to dynamically alter the content in a *ResulSet* object.

One of the projects we have used in teaching Corporate Intranet Development class is the Company's

Sales Information database. The database contains information such as products, descriptions, costs, units sold, etc. The database is developed by using Microsoft Access. To run the database on the company's Intranet or World Wide Web, the Access ODBC is installed on the Web server. The Java program instantiates the JDBC/ODBC driver which is used to query the database. The Java program also provides the graphical user interface with the textfields, panels, and buttons. With these panels and buttons, a student can select a specific database to work with. Over the Intranet or World Wide Web, students can view and search the database, add or delete a salesperson's record, modify a field, such as the field of work hours, and redesign a table interactively. Students can even test a query for a selected database on the Web. Once their work is completed, students can submit their homework through the Internet. Many students have developed various real world Web database applications. They have developed projects such as dynamic stock watch which gives stock figures and charts instantly. The graphical user interface allows the user to choose stocks. Among other business applications, the pizza delivery system is an interesting one. It has a city map on the pizza ordering applet. When a customer clicks the street where he/she lives, the street information is passed to the pizza delivery person, so that the person will know how to find the customer.

3. Conclusion

Web databases are not only necessary tools for the e-business, but also provide a convenient tool for teaching and learning. The Web databases provide a first-hand experience on developing real world projects in the database teaching environment. Nowadays, as the Web databases become more and more important for doing business on the Internet, the work that students have done by experimenting and developing Web databases makes them ready for the e-commerce related jobs. Helping students prepare for real world jobs is part of the goal of classroom teaching. A web database is an ever more popular vehicle for achieving this goal. There are many books available to help faculty members on developing Web databases. The book *Java: How to Program* by H.M. Deitel and P.J. Deitel (1999), gives clear and step by step instructions on building a Web database and writing Java codes. The book *Database Management System* by R. Ramakrishnan and J. Gehrke (1998) provides a lot of useful information about Internet database concepts. If Visual J++ 6 is used to develop the Java-based Web databases, the book *Visual J++ 6 Secrets* by Chuck Wood (1999) gives a complete coverage of Visual J++ 6. This book also points out the difference between Microsoft's Visual J++ 6 and the standard Java.

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MOVING TOWARD A WEB-BASED INSTRUCTIONAL DELIVERY MODEL FOR GRADUATE EDUCATION: A CASE STUDY

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Abstract: This paper provides a description of the change model process used by the Marshall University Graduate School of Education and Professional Development to transition to a web-based instructional delivery system. Elements of the change/transition model are outlined and problem/barriers that have been encountered are discussed. Student survey responses to web-based instruction are presented and a list of unanticipated outcomes is presented and discussed. Finally, guidelines/implications for other institutions considering moving to a web-based instructional model are presented.

Introduction

As colleges and universities are coming under increasing pressure to take advantage of the opportunities provided by technology to better serve today's diverse student populations, new strategies for involving faculty must be developed. The identification of a change model/process to move a college or university toward widespread acceptance and use of technology-based instruction is a continuing challenge for deans and system administrators.

The Marshall University Graduate School of Education and Professional Development has developed and is successfully implementing a transition to a web-based instructional delivery system. Beginning with the involvement of two faculty members in web-based delivery two years ago, the School now has more than half of the full-time and several part-time faculty (more than 40 individuals) using web-based course delivery. More than 100 courses, one-degree program and one professional development program are essentially web-based. Variables driving the change model include relationship to mission, use of "bridge" personnel, student training and receptivity, faculty development and acceptance, and system support.

The Setting

Marshall University, an institution of 16,000 students with the main campus located in Huntington, West Virginia, has 450+ courses and 9,000+ students enrolled in classes that use a web-based format for instructional delivery. The Marshall University Graduate School of Education and Professional Development (GSEPD) is the graduate professional education arm of the University and is headquartered in South Charleston, West Virginia. Programs are delivered throughout West Virginia using a small number of dedicated full-time faculty complemented by a cadre of expert part-time faculty recruited from higher education institutions, school systems and other agencies.

Faculty Involvement

Securing, nurturing and maintaining faculty involvement in web-based instructional delivery is a major challenge. The model used to facilitate faculty involvement could best be described as planned gradualism. Elements of this model include faculty discussion groups, demonstration of existing courses, hands-on group computer lab sessions and one to one faculty mentoring. The collaborative relationship between the college's faculty - technology liaison, faculty members, instructional technologists, and computing service personnel also serves as a unique element of the model. A method for monitoring the progress of new users is also included.

Student Training

Marshall University Graduate College (MUGC) serves mostly non-traditional, working adult students in a rural environment that makes web-based instruction an increasingly essential element for course delivery. Delivering training to students in the use of the delivery software is, however, a challenge because of the geographical diversity of students and the time constraints inherent with adult learners. The solution to this problem that has evolved is the development of a "Super Saturday" training session for all new users. This session is held just prior to the semester's beginning with experienced faculty members serving as trainers and less-seasoned faculty serving as assistants. The one hour sessions begin at 9:00 a.m. and as many as 300 students have been trained on a single Saturday.

Student Response

In an effort to assess the impact of web-based instruction on students, the School has routinely conducted follow-up student surveys. These survey results indicate: 66% of the students indicated that they accessed the courses from their homes and 28% from their work sites; 66% of the students attended a training workshop prior to beginning the first course; 66% of the respondents reported that they experienced no technical difficulties accessing the courses; 63% of the respondents recommended that two to four "live" class meetings should be held per course; 85% of the students reported that the live class meetings were helpful; 91% of the students rated the quality of the web-based courses as 'good' to 'excellent'; 80% of the survey respondents indicated that they had received instructional value equivalent to a traditional graduate course from their web-based courses; 94% of the respondents reported that they would be willing to take another web-based course; and 93% responded that they would recommend a web-based course to others.

Unanticipated Outcomes

The original goal for moving toward a web-based instructional delivery model was to provide increased program and course access for working professionals. Additionally, the model continues to generate a number of other unanticipated outcomes: faculty appear to be more attentive to course development and cross-disciplinary interaction has increased; a differentiated staffing model involving new roles for full-time and part-time faculty is emerging; a broader array of instructional strategies is being used; a new sense of collegiality and sharing is emerging; instructional resources are continually updated and expanded; and we are rethinking our approach to student assessment.

Problems/Issues

The move to a web-based instructional delivery model has not been problem free. Several problems and issues have emerged. Web-based instructional delivery is highly labor intensive. Providing system support (technology and personnel) is an ongoing challenge. Finding the resources to maintain up-to-date hardware and software is a problem. Finally, the move to a web-based model results in an environment of almost constant change.

Summary

The transition from a traditional course delivery model to a web-based model has been a challenge for the MUGC Graduate School of Education and Professional Development. It is, however, a challenge which faculty and students have embraced with great enthusiasm and commitment.

An Intelligent User Interface oriented to non-expert users

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Abstract: This paper presents the design criteria for an Intelligent User Interface to a search engine of an on-line document data base. The Interface is aimed at users that have little or no knowledge of the specific terms and keywords used by experts in the field, and allows an easy navigation without requiring to type any query string. While the user navigates, the Interface infers a model of his/her interests, and activates suitable searches on behalf of the user.

Introduction

The fast development of the Internet and of multimedia technologies opened new possibilities for accessing information of different nature on a global scale. However, for the majority of people, computer skills and Internet application knowledge are not adequate and still prevent mass deployment of the available information.

The access to the enormous amount of data and information available on the Internet is made possible by *search engines* [1], that allow users to find web pages matching some search criteria, and that are a critical technology for delivering the right information. Search engines are becoming more and more sophisticated, but are suitable only for the users with moderate *computer skills* and a *basic knowledge* of the topic under search: both aspects are required for being able to formulate clever search keywords and to combine them.

This paper describes the experience in designing an Intelligent User Interface (IUI) within an EU-funded Socrates project, called MOISE (International Organizational service Model for people with Special Educational needs). The project aims at producing, collecting and distributing a large number of documents concerning didactical methodologies used throughout Europe for students with disabilities or other special educational needs. Since one of its social objectives is usability, it requires a well-designed model of the interactions with different types of users. Access to the data base must be designed for users with limited computer skills. In particular, three classes of users are considered:

- *information-providers*: people with valuable knowledge concerning disability in the educational process, willing to share their information and contribute it to the data base (teachers, psychologists, doctors, and in general operators in the educational field).
- *information-consumers*: people interested, at various levels, to the information loaded by the *providers* (students of related disciplines, parents of children with special educational needs, and disabled people).
- *database maintainer*: technically skilled people that collect documents and insert them into the data base.

The main characteristics of the different classes of users are summarized in the following table.

	Actor		
	information provider	*information consumer*	*database maintainer*
Basic computer skills (browsers and office applications)	high	moderate	high
Advanced computer skills (databases and web applications)	low	none	high
Expertise on the field (special educational needs)	high	low	none

Retrieval systems accessible on the Internet are nearly totally unsuitable for interaction with computer-illiterate and non-expert users. Most search engines [3] work through *key words*, sometimes hierarchically organized, whose understanding and knowledge requires a certain degree of familiarity with the topic being searched (in this case, special educational needs). To enhance the accessibility of the data base, we need an *Intelligent User Interface* (IUI), able to guide the users in the choices and to propose him or her different paths of investigation.

The enabling strategy for the development of an IUI is the availability of accurate and detailed meta-information about all the documents in the system. User-guided searches can be constructed only if structured information *about* these documents (meta-information) [2] is loaded into the database, so that each document is carefully classified, both in absolute terms and with respect to other documents. The availability of meta-information is not a technical problem, but a cultural one: experience showed that information-providers were unable to clearly understand the idea and the usefulness of meta-information, basically due to their lack of competence on data base systems. To fill this gap, we developed a simple yet effective *metaphor*, that allowed information-providers to specify the required meta-information in a format they could clearly understand. The chosen metaphor is based on a standard "cover page" that information-providers have to fill before sending the document to the database maintainers.

User Interface for Information-Consumers

The on-line archive for special educational needs consists of all the documents contributed by the information-providers and the associated meta-information, coming from the analysis of the cover page. The archive is aimed at a broad category of users, that includes students, educators, families and other individuals, including disabled people. The variety of the users requires the study and the implementation of several different *levels of access*, i.e., of different user interfaces. Assuming the ability of using a browser program, we divided the users in two categories, experts and non-experts, according to their level of knowledge of the *topic* (special educational needs).

While a simpler user interface, based on keyword search, is enough for expert users, the user interface for non-expert users must be significantly more complex, since it must guide them step-by-step from the general concepts to the documents in the data base.

The criteria for developing an Intelligent User Interface (IUI) for non-expert users were studied by a working group composed of computer engineers, experts of disability in education and experts of cognitive psychology. The group defined a set of requirements to guarantee an effective communication, where the most important is *circularity* of information: the user selects some items among the information presented by the machine, and the machine proposes new information based on the user selections, in an endless circular process.

The navigation model is based on a gradual approach to the topic, starting from general information and going towards the documents. The user never has to type any text, and the interface proposes possible choices based on the current information available to the IUI. All specific terms are *contextualized*, i.e., never appear alone (as in a list of keywords) but are always parts of a complete sentence.

Navigation is based on a set of brief introductory texts over the topic of special educational needs: the user is invited to read concise descriptions that describe the different aspects of the topic. Such descriptions (*summaries*) are 100-200 words long and are organized in an hypertext structure, so that the user can freely browse and read the information that most accurately matches his or her interests. Summaries have a dual role: *informing* the user about the basic aspects of the topic, and *gathering information* about user interests. Each summary is associated to some keywords of the cover page, and from the sequence of followed links we can infer the user interests. While the user freely browses through the hypertext composed of the summaries, the application level of the IUI builds a *model* of the user, by assigning relative weights to the different fields of the cover page. Each time the user follows a link, the IUI infers that he or she is interested in the information connected to that link *more* that other links in the same page: the weights that model the user are updated accordingly. On the basis of the user model, the application level transparently queries the data base, and analyzes the list of matching documents. As soon as the number of documents found by these queries becomes small, the IUI proposes to the user the list of such documents.

Once the IUI has built an accurate model of the user, it transparently activates new search levels: initially, only the hypertext summaries are used; in a second level also relevant document abstracts are presented to the user; a third level presents the detailed cover page. The switch to lower levels happens when the IUI has enough information about the user interests, and is designed to present greater detail over a smaller set of topics.

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ERAU's eTeaching Zone: A Virtual User's Community for Web Instructors

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Abstract: With 130 teaching sites around the world, Embry-Riddle Aeronautical University faces unique challenges in supporting faculty who want to use the web for instruction. While faculty members have been able to learn how to use the web via online modules, there has been little opportunity for them to share ideas and learn from each other. The eTeaching Zone enables faculty members to collaborate with peers, stay abreast of WBI developments, access support, and, most importantly, feel that they are part of an important instructional initiative of the University.

Profile of Community Members

The eTeaching Zone is a community for all ERAU faculty members who use the web for instruction. Like most communities it consists of a diverse population. Some faculty members teach totally online courses, while others are just beginning to post a syllabus and a few course notes. In the eTeaching Zone, the novice benefits from the experience of the accomplished, the experienced user gains fresh insights from the novice, and everyone can solicit advice for new undertakings.

Community Planning

The eTeaching Zone is a planned community. Before its inception, research was conducted to determine what qualities make virtual communities and web portals successful. Several common factors for success emerged. Effective communities are built around a common interest, pertinent content, group identification, a sense of belonging, and opportunities to participate. The key element in the success of an online community is its ability to attract continued participation by its members. Members in an online community must perceive it as valuable to them and that they are a vital part of it.

Community Components

The inaugural version of the eTeaching Zone started off with a tour to orient new members to the community. The primary components of the community were a bulletin board, online resources, a gallery of example courses, and an eLounge. The bulletin board was used to discuss educational technology issues and to post help questions to the group. The online resources provided access to educational technology links, ERAU web resources, an EPSS for ERAU web tools, an educational technology calendar, and online tutorials developed by the ERAU Ed Tech Team. The gallery contains links to ERAU and other courses with web components. The eLounge was designed to be a place to escape and have fun. It contained jokes, games, and aviation related interest items.

Community Development

The initial development of the community consisted of creating a "look and feel" for the community, posting the original bulletin board topics, creating web pages with links to various resources and educational technology news and events, and finding resources for the eLounge. The community was developed in WebCT utilizing its bulletin board, calendar, and tracking tools. Tracking member usage of the community and the various components provided information for continual revision of the community to improve its usefulness.

Community Evolution

The eTeaching Zone was opened to the ERAU web faculty without all the components planned for it. In order to establish that it would be a constantly changing and growing environment, several resources were purposely not included in the original community so they could be added in the first several weeks. The idea was that continued additions to the community would promote continued interest and return visits.

As all communities do, the eTeaching Zone has changed over time. Following the initial planned additions to the community, other changes and additions were made on the basis of member usage and suggestions.

Future Development

The eTeaching Zone is somewhat of a living being. With the changes in web technology and accompanying changes in the instructional implementation of the web, there is no doubt that the community will change accordingly. The focus for the future is to make the adaptations necessary to keep the eTeaching Zone a vital community for the Embry-Riddle Aeronautical University web faculty.

Introducing Internet and Intranet Technologies to a Port Authority

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Abstract: In this paper, we present a system based on the integration of Internet, Intranet and database technologies and implemented for Patras' Port Authority in Greece. The system intends to modernize and automate the Port Authority's working practices through the introduction of new technologies. Its main goals were to facilitate the exchange of information among the Port Authority's various departments, to provide useful information to the public, to facilitate the exchange of statistical data between the shipping agents and the Port Authority's corresponding employees. The introduction of these new technologies however, raised the issue of training employees with varying backgrounds in using them. For this purpose, the system includes a training application using various educational patterns.

1. Introduction

Nowadays, the Internet plays a key role in almost all, if not all, the business activities. (December & Randall, 1996; Ford & Dixon, 1996). An increasing number of organizations (e.g. civil services) are adopting the use of Internet and Intranet technologies in their working environment in order to facilitate and automate their working tasks (Casselberry, 1996). The employees of such organizations acquire valid and on-time information saving thus time and movement (Bernard, 1996). The advantages are multiplied in case of an organization that frequent interacts with the public. A significant amount of information becomes available to the public through the Web reducing the employees' workload and facilitating the citizens' contact with the organization (Hettihewa, 1997).

This paper presents a system based on the integration of Internet, Intranet and database technologies and implemented for Patras' Port Authority in Greece. The system's implementation was the result of a project aiming to modernize the Port Authority's working practices through the introduction of Internet and Intranet technologies (Derekenaris et al., 2000). Its primary objectives were to provide useful information to the public regarding the activities of Patras' Port, to enhance the cooperation between the Port Authority's various departments and to automate the procedure of statistical data exchange between the shipping agents and the Port Authority's corresponding employees. The introduction of these new technologies however, raised the issue of acquainting the employees with their use. This process may turn out to be rather difficult as well as time-consuming. To make things easier, an Intranet-based application was developed for their training.

2. System Overview

Patras' Port Authority consists of various departments such as the Administration Department, the Technical Department, the Department of Electromechanical Installations, etc. These departments are dispersed and therefore one of the expected benefits deriving from the system's operation is the saving of time and movement for the employees. This constitutes a key functionality of the system. Two departments playing a key role in the interaction of the Port Authority with the public and the various shipping agents located in

Patras are the Marina Department and the Shipping Agents Department respectively. The former supervises the operation of Patras' Marina whereas the latter records statistical information regarding the amount of cargo as well as the number of passengers and vehicles carried by ships and ferries arriving and departing from Patras' Port.

The main concept of the project was to develop an Internet and Intranet based system for information purposes. The user gains access to the system through a Web browser. The services provided by the system are briefly outlined below:

a) Provision of information regarding Patras' Port to the citizens (e.g. potential travelers) through the WWW.

b) A bulletin board, that is a shared location supporting the posting and viewing of electronic announcements.

c) An application for Patras' Marina enabling craft owners to apply on-line for docking space and the Marina' s personnel to manage the corresponding data through a Web user interface.

d) An application, which enables the shipping agents to submit statistical data to the Port Authority and the Port Authority's corresponding personnel to manage it.

e) An Intranet-based application for training the Port Authority's employees to the use of the newly introduced technologies.

3. Implementation Aspects and User Views

For the development of the system the Microsoft Internet Information Server for Windows NT was used. Active Server Pages scripts were used to manipulate the information stored in the databases and to dynamically produce the contents of the applications presented to the users.

The user interface is unified offering different view to different users. We can distinguish the following basic views as far as the users are concerned:

1) Citizen View: In the citizen view, the user can access through the WWW all available information regarding the Port Authority's activities and concerning the public.

2) T*ypical Port Authority Employee View:* In this view, the user can read and post announcements to the bulletin board. Moreover, the user can modify the announcements he/she has posted. Finally, access to the training application is possible.

3) Shipping Agents Department View: In this view, the user can perform all the actions permitted to a typical Port Authority employee and additionally manage the data acquired from the shipping agents.

4) Marina Department View: In this view, the user can perform all the actions permitted to a typical Port Authority employee and additionally access the Patras' Marina service.

5) Shipping Agents View: This view enables the shipping agents to submit statistical data to the Shipping Agents Department.

6) System Administrator View: In this view, the user can access all available information.

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The Role of the Center for Excellence in Mentoring Web Site in Preparing Teacher Candidates to Develop and Delivery Technology-Rich Lesson Plans

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Abstract: This paper describes the role of the Center for Excellence in Mentoring (CEM) Web site in the context of a one-year capacity building grant funded by the U.S. Department of Education's Preparing Tomorrow's Teachers to Use Technology. First, the need of the grant project is discussed. Secondly, the response to this need--an interactive professional development technology practicum is described. Thirdly, the Center for Excellence in Mentoring (CEM) Web site activities in the grant project are noted, including the Web site's use to provide communication tools, and program information and materials, as well as serve as vehicle to disseminate the results of this grant project.

Introduction

The University of Houston-Clear Lake (UHCL) in partnership with eight rural and urban school districts in the Houston, Texas area, called the UHCL Collaborative, has established a successful, field-based teacher preparation program. The UHCL Collaborative received a one-year capacity building grant from the United States Department of Education for 1999-2000 to design a model to prepare teacher candidates to be proficient in developing and delivering classroom lessons that integrate technology within the curriculum. Recently, the U. S. Department of Education supported the continued development of this project with a three-year implementation grant. These lesson plans (guided by standards) would effectively incorporate technology in the learning process so that all students (Pre-K to 12th grade) demonstrate technology integration (exercising higher order thinking skills) in their assignments. The development and use of a newly created Web site, entitled the Center for Excellence in Mentoring (CEM), serves a primary role in the learning process for teacher candidates in the development of lesson plans.

Need for the Project

In our local and regional public schools as well as schools throughout the United States, the ability to incorporate technology within the curriculum is one of the most difficult tasks for teachers in the United States (Benton Report, 1997; Driskell, 1999). The central proof of a teacher's ability to effectively incorporate technology within the curriculum is the development and delivery of classroom lesson plans that integrate technology into the content and pedagogy so students use technology to demonstrate mastery of lesson plan objectives. For integration of technology to occur within the curriculum, ten factors have to be incorporated in a professional teacher preparation program (Driskell, 1999).

The ten factors are (1) access to technology tools, (2) technology training, (3) pedagogy behind effective integration of technology, (4) assessment of teacher candidates' skills using technology effectively in the classroom, (5) model lesson plans that demonstrate technology integration within the curriculum, (6) incentives for teacher candidates to integrate technology within the curriculum, (7) time for teacher candidates to learn about and plan for technology use, (8) school climate that encourages use of technology resources in innovative ways, (9) collaboration with teachers (teacher candidates and mentor-teachers) about technology integration, and (10) technology integration support. See Figure 1 below.

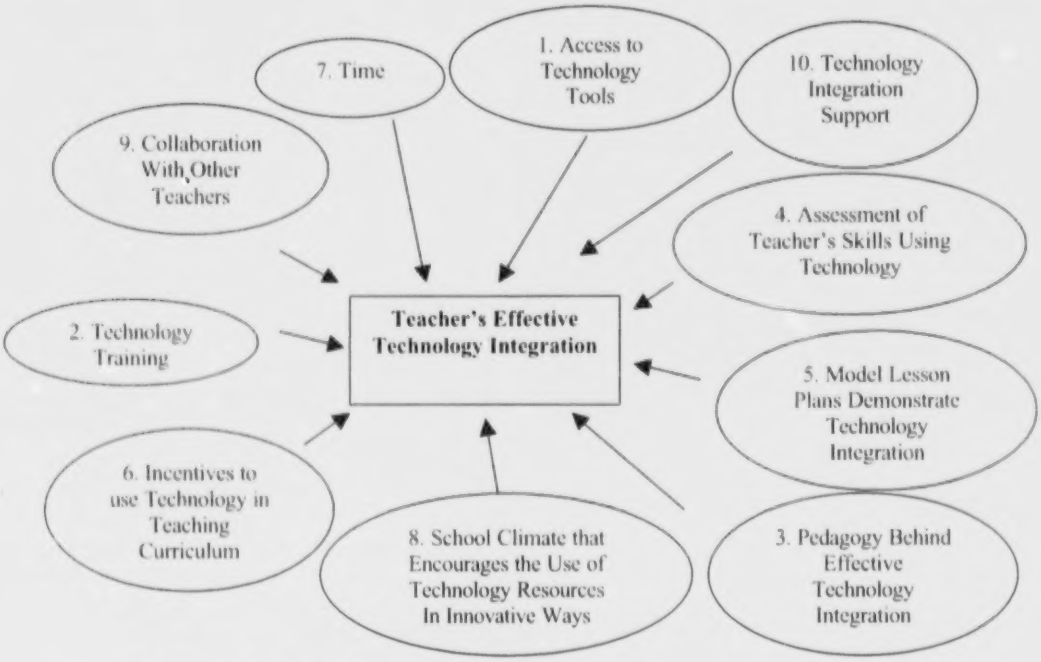
7. Time
1. Access to Technology Tools
10. Technology Integration Support
9. Collaboration With Other Teachers
4. Assessment of Teacher's Skills Using Technology
Teacher's Effective Technology Integration
2. Technology Training
5. Model Lesson Plans Demonstrate Technology Integration
6. Incentives to use Technology in Teaching Curriculum
8. School Climate that Encourages the Use of Technology Resources In Innovative Ways
3. Pedagogy Behind Effective Technology Integration

Figure 1: Factors that effect the integration of technology into the curriculum. The design and development of HELPER, constructivist lesson plan web resource to model technology integration (Driskell, T., 1999).

An Interactive Professional Development Technology Practicum

During the capacity building study, the UHCL Collaborative developed a three-day, interactive professional development technology practicum to prepare teacher candidates to develop and deliver lesson plans that integrated technology within the curriculum. For novice computer operators only, an additional one-day basic technology skills session was provided prior to the three-day technology practicum. Teacher candidates, along with their mentor-teachers and university faculty, became proficient in the application of technologies, gained understanding of the pedagogy behind the specific technology's usage, and collaboratively developed authentic lesson plans that integrated technology. Participants used a designed lesson plan template found on the Center for Excellence in Mentoring Web site (http://www.cl.uh.edu/soe/cem/mentoringcenter/). Lesson plans were assessed for appropriateness and completeness using a designed lesson plan rubric. Then, teacher candidates presented their lesson plans to the classroom students (Pre-K to 12th grade), and student products (using technology applications) demonstrated mastery of the lesson plan objective. The technology consultant and project evaluator assessed student products for relevance and completeness. This developmental process allowed teacher candidates to assess their own progress in developing and delivering technology-integrated lesson plans, as well as improving their delivered lesson plans. Teacher candidates published (showcased) their lesson plans on the UHCL CEM Web site.

After completing the three-day professional development technology practicum, participants were provided ongoing professional support via the Center for Excellence in Mentoring (CEM) Web site as they developed and delivered lesson plans in the classroom. Ongoing professional support for participants was a critical element of success (Brooks, & Kopp, 1989; International Society for Technology in Education, 1992; Sheingold, 1991; Benton Report, 1997), especially in a constructivist learning environment (Wilson, 1996).

The interactive professional development technology practicum was successful in addressing the ten factors (See Figure 1) that effect the integration of technology into the curriculum. Table 1 below indicates how each factor was addressed.

Table 1: How the Ten Factors Were Addressed during the Project

1. Access to Technology Tools	Technology training matched the technology tools available at participants' campuses.
2. Technology Training	The grant provided 18 hours of hands-on technology training linked to the state technology standards.
3. Pedagogy Behind Effective Technology Integration	Understanding the most effective method for integration of technology was a focus for the training of preservice teachers, mentor-teachers, and university faculty.
4. Assessment of Teacher's Skills Using Technology	Each participant received assessment reviews for their lesson plans.
5. Model Lesson Plans Demonstrate Technology Integration	Model lesson plans were accessed through the CEM Web site.
6. Incentives to use Technology in Teaching Curriculum	Incentives were given to each campus that participated in the grant project.
7. Time	Grant participants were provided time to ask questions and to experiment with various new technology skills and knowledge components during training sessions.
8. School Climate that Encourages the Use of Technology Resources In Innovative Ways	Administrators endorsing this grant effort promoted teachers' technology usage with students.
9. Collaboration With Other Teachers	Working together to share and ask questions was a major component of the grant. Collaboration occurred by telementoring as well as face-to-face during the training.
10. Technology Integration Support	Each participant had follow-up technology support from the university and campus levels.

The three-day technology practicum also addressed the needs of economically disadvantaged campuses as well as all others campuses included many elements. Sample components include: (a) vision of student-centered technology-rich classroom environments, (b) technology integration with one (few) computers in a classroom, (c) guidance of students in creating successful multimedia presentations using multimedia software, (d) guidance of students in exercising higher order thinking skills in technology use, (e) application of electronic educational templates, (f) technology and performance standards in lesson plans, (g) development of student electronic journals, book reports, and technology portfolios, (h) guidance of students in researching on the Internet and (i) effective use of telecommunication tools in education.

The "Center for Excellence in Mentoring" (CEM) Web site

During the capacity building grant the UHCL CEM Web site was developed to provide communication tools between participants affording virtual support and development, program information and materials, a reservoir of model lesson plans, and a public location to showcase teacher candidates' lesson plans (http://www.cl.uh.edu/soe/cem/mentoringcenter/). This Web site included sites for each campus to communicate by chat rooms, web boards and listservs.

The CEM Web site will be expanded to include more sites for new partner campuses to provide campus specific communications between participants. Moreover, it will serve as a central clearinghouse for information between teacher participants, linking teacher candidates and mentor-teachers with campus and university technology experts. The Web site holdings (library) of lesson plans *(Webscapes for Learning: Teachers as Information Architects)*, curriculum standards, and Internet resources for technology learning will be expanded. The CEM Web site will be linked to resource sites for educators to model technology integration. For instance, it will be linked to the Texas Learner Academy, (http://www.edb.utexas.edu/academy) at the University of Texas in Austin.

A biannual, interactive online colloquia via the CEM Web site on lesson plan development and delivery is planned to provide teacher candidates an opportunity to discuss their experiences in technology integration in the classroom. This activity will provide an opportunity for teacher candidates to showcase their work integrating technology in the curriculum through lesson plans. During these colloquia, teacher candidates can describe effective alternative strategies in working with a heterogeneous classroom having various levels of technology proficiency among students to ensure equity in technology application, exercising higher order thinking skills.

The Center for Excellence in Mentoring (CEM) Web site will serve to make available this professional development approach to lesson planning to teacher preparation programs throughout the United States. Moreover, research findings surrounding the program will be publish on the CEM Web site. Publications on this project are especially important since the ability to incorporate technology within the curriculum is one of the most difficult tasks for teachers in the United States (Benton Report, 1997; Driskell, 1999).

Conclusion

During the capacity building study, teacher candidates along with their mentor-teachers and university faculty participated in this program to prepare teacher candidates in developing and delivering lesson plans that integrate technology within the curriculum. The process addressed the three agendas for school reform in the information age: (a) developing agreement about learning and teaching, (b) highly integrated usage of technology, and (c) restructuring (Mehlinger, 1996). Participants discussed the pedagogy of technology integration, developed confidence and competence in using technology applications to become proficient in developing and delivering lesson plans that incorporated technology, and began describing ways to restructure learning in the classroom, making it more active, and student-oriented. The Center for Excellence in Mentoring (CEM) Web site played a key role in this development providing information, communication, and support. As one principal in the UHCL Collaborative declared, "The operations of this grant has moved our school into a new century."

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Website Evaluation System: Collaboratively Discovering what makes a Website Good

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Introduction

This short paper examines a method for the collaborative discovery of metadata, one of several uses of CoFIND (Collaborative Filter in n dimensions) first presented at WebNet 99 (Dron et al 1999). We will discuss an implementation of the system customised to collaboratively evaluate a limited range of websites.

In its full version ,CoFIND is developing into a self-organising learning environment, but in the iteration discussed here it has been cut down to only provide a means of rating a static list of web pages. Ratings may be in the form of comments and discussions using a built-in discussion mechanism. However, the main means of rating is through the use of *qualities*. Qualities are the things that users find valuable about web pages, and are entered by the users of the system themselves. These provide the n dimensions referred to in CoFIND's name, providing more dimensions of evaluation than the two-dimensional scales found in typical collaborative filters.

To prevent immoderate growth of qualities they are subject to evolutionary forces. Successful qualities are those that are used frequently to rate and/or to seek web pages. Success is rewarded by a higher position on the list of selectable qualities, whilst failure means slipping down that list and eventually falling off the end if out-competed by other qualities. A feedback loop is formed between the list of resources and the qualities used to assess them. If a quality provides a list or resources of use to the user then it is more likely to be selected again.

We performed this experiment to explore the potential for using CoFIND to identify the issues that are important to users when visiting web sites. The results should not be considered as an objective assessment of the qualities users seek to find or avoid but more as a piece of action research to find out how it should be done.

The experiment

The short (five day) experiment involved a group of fifty University of Brighton level two students at the start of their Human-Computer Interface (HCI) module. The students were all very familiar with using the web but had not yet studied HCI in any detail.

Twenty websites were carefully chosen by the tutors of the course to cover a wide range of subjects and HCI issues. All the sites had good points but the tutors considered that each suffered one or more weakness in their design for usability. These sites were entered into CoFIND by the lead tutor. The students were strongly encouraged to rate the resources using the existing qualities or (should they prove insufficient) to add new qualities. Students were also free to use the discussion mechanism to comment on the resources if they wished, but there was no requirement for them to do so.

The main learning objective of the exercise was to encourage the students to evaluate and reflect on what was good or bad about web pages and thus by active experimentation to reflect on the issues surrounding HCI. The system was seeded with four qualities (*frustrating, hard-to-use, attractive, interesting content*), mainly by way of example. These qualities were used by the lead tutor to rate the resources as he saw fit, so that from the start selecting any quality would produce a list of relevant resources.

All students were asked to contribute to the system by evaluating at least ten sites and, if they felt the existing qualities to be inadequate to capture their thoughts, to add new ones.

Experimental results

Over the course of the experiment the students added twelve new qualities to evaluate the websites: *Slow, Boring, Confusing, Navigation, Orientation, Appropriate Links, Innovative, Association Member, Author Info, Fun, Artistic* and *informative*.

By far the most popular qualities used to rate sites were *informative* and *attractive* which is not very surprising, but we were puzzled by the appearance near the top of the list of the quality *Author info*. This is not a quality of web sites that is often picked up as highly significant by writers on the subject . Although our results are far from unbiased and are not experimentally controlled this begins to hint that were we to extend the system to a wider audience that some surprising information might be generated of use to web designers and those seeking to rate and classify web-based resources.

Three sites stood out in terms of numbers of ratings received: the University of Brighton's own site (understandable in the context), SNARG (http://snarg.net a remarkable web art installation about which it is very hard to be neutral) and to a lesser extent the site for the Beano (a popular and enduring British children's comic). The ratings achieved for each of these sites were very mixed and help to show that a typical good-bad range of votes as used by a conventional collaborative filter fails to capture the subtlety of feelings that mark out a user's attitude to a site. For example, SNARG achieved high ratings for positive quality of *innovative* as well as the negative quality of *confusing* whilst getting low ratings for *hard-to-use* and *frustrating* (i.e. users felt that it was not hard-to-use and not frustrating). Despite being a dedicatedly visual site which presents itself as a work of art, SNARG received low-average ratings for *attractive* and *artistic*. It would have been hard to have gleaned this information using traditional two-dimensional numeric ratings and much more difficult to glean a consensus opinion using conventional seals of approval such as abstracts and critiques. Had we provided the students with pre-entered qualities we would not have come up with *Author info* or *Association member*.

Only seventeen of the twenty resources were rated by the students. The three unrated resources were not hidden away at the bottom of the list of the returned resources for any of the originally entered qualities, so it is tempting to conclude that students were put off the sites by their descriptions. Unfortunately the mechanism for recording use of links to the sites suffered from a bug but we strongly suspect that the unrated sites were not visited. As the task only required the students to visit and rate ten sites and as their workload was high and motivation perhaps a little weak, it is likely that most students did not visit that many more sites than the required minimum. If this is so then it seems to imply that the first level of filtering takes place without regard to ratings, a matter of some concern to those seeking to achieve more hits for their sites.

No one chose to make any comments or start a discussion, which helps to confirm that the students were unwilling to participate further than the task demanded.

We have not been able to find out what level of informal networking took place outside the context of the trial. As all the students were able to talk to each other throughout the experiment it is likely that they discussed the sites and their reactions to them. We would not wish to discourage this as it is pedagogically very sound, but it almost certainly skewed the results.

Conclusions

This was not a controlled experiment and we should be wary of drawing any significant conclusions about the data gathered. However, CoFIND has proved itself capable of generating useful metadata about what is of value in a web site. We must now perform larger scale controlled experiments to identify the precise nature of those metadata. Our experiment also suggests that the description of a site plays a significant role in drawing users to view it, but this too needs further controlled investigation.

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Experimenting on Average Performance in Web Serving

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Abstract: In this paper we present experimental results which concern measurements on an experimental web server by using the Inetload monitoring tool. We extract useful results on the inter-relation between the number of child processes and the average server's performance.

Introduction

The main goal of this paper is the measurement of the most important parameters, which have immediate relevance to the performance of a Web Server. The parameters that will be examined are the average time of a requested page to be served and the average size of the pages that are served.
These parameters will be measured as a function of two simpler parameters: a) The number of users that access the server. b) The number of the child processes that have been configured to the web server so as to manage the requests for pages from network users. We are going to measure the main parameters under several conditions of server's state. There are several tools for synthetic load generation or web server benchmarks in web servers. The most important are InetLoad [Inetload], SURGE [Barford & Crovella 98] and SPECweb [SPECweb96]. In our case we used the InetLoad V2.0 tool for generating traffic and to conduct all out experiments.

Measurements

Inetload supplies the user with a very friendly interface, which consists of three different regions:
Region 1: It is common for all the protocols and it consists of the following fields: 1) Specify the IP address of the server against which the simulation is running, 2) The program creates a log file if the relevant box is checked, 3) Specify the number of active users to be simulated. The users must execute sleep commands between the other commands so as to prevent a bottleneck (especially when the users are more than 500), 4) Specify the number of worker threads that will process requests (maximum is 50), 5) Specify the user start delay which is the number of milliseconds for the Inetload program to wait before starting the next user. This parameter is used to prevent a storm of new users at the beginning of a new run, 6) Specify the test duration in minutes.
Region 2: This region consists of special parameters according to the protocol used. For the HTTP protocol that we use during the measurements, the most important parameters are: 1)

Specify the name of the script file that is going to run, 2) Specify the way that the HTTP protocol is going to handle the cookie processing, 3) Specify in seconds how long a client should wait for an answer from the server before timing out, abandoning the call and continuing with the next command.

Region 3: It is called "Test status panel" and it contains information about the current test and counters for the different protocols. The fields are: 1) The current test duration that shows how long the test has been running, 2) The number of dead users because of the corruption of their data structure, 3) A counter that increases only if the test runs successfully, 4) Specific counters for the HTTP protocol which are: a) The number of connections to the server until now, b) The number of unsuccessful connections, c) The total number of pages that have been transferred by all the users, d) The total number of images that have been transferred, e) The number of successful responses, f) The number of faulty responses.

When Inetload has finished its execution, two log files are generated: The file access_log which is generated by the server and the file log which is generated by the Inetload program during its execution. From these two log files we can extract useful information which are: The latency time in milliseconds which refers to the difference between the time that a client sends a command to the server and the time that the client got a response, Each client has a different identification number so as to be separated from the others, The exact command that was sent to the server, The first line of the response that the client received from the server, The exact date and time that the transaction took place, The number of bytes that were sent to the client, The name of the file that was asked for by the client, The identity of the child process that served the request of the client, The time duration of the request to be served. The tests performed are briefly described below:

First measurement: The Inetload program was run for different number of users for the same time duration each time and with the same parameters of the Inetload program and with the same number of child processes used by the server. The results are summarized in the [Fig. 1] of [Extended], where we use the following signs: # = number of, Us. = users, SC = successful connections, PT = pages transferred, SR = successful responses, FR = faulty responses.

Second measurement: We compute the average latency in milliseconds as a function of the number of users. The x-axis multiplied by 100 shows the number of users.

Third measurement: We compute the average time to get a page and the average number of bytes transferred as a function of the number of users.

Fourth measurement: In this measurement we change the number of child processes of the server that are occupied with the service of the requests so as to see how the average response time changes. The number of users is kept constant to 100. The parameters that are changed are made to the APACHE configuration file and account for: The minimum number of spare servers (MiSS), the maximum number of spare servers (MaSS) and the number of start servers (SS). The results of this experiment are being presented in [Fig. 4] of [Extended]:

Results & Conclusions

The conclusions that can be derived from the measurements above are the following:

- The performance of the Web server is very good only if the number of users is less than 300. When the users exceed 400, the average response time increases a lot. This happens because the server is overloaded, so it cannot serve all the users almost concurrently. If the number of users exceeds 500 then we can observe the inability of the server to serve all the users so it serves some of them incidentally and the others are not served at all (zero response number for zero bytes transferred).

- During the fourth measurement we have changed the number of child processes for a given number of users (100) so as to observe the variability of the average response time. The average response time is improved noticeably when 4 child processes are disposed. Between 4 and 40 child processes used, there is a medium increase in the average response time.

In [Menasce, et.al 98] it is documented that using multiple children decreases the average time per request. Since all server processes content for the same hardware resources (e.g. CPU, Memory), the performance improvement saturates after the underlying hardware resources are close to 100% utilization. Significant reduction in the response time is achieved when the number of children goes from one to two. A smaller improvement is observed when an additional child is added. From four children on, the improvement is negligible.

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A Web-Based Solution for Institutional Compliance

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Abstract: Institutional compliance programs manage large amounts of data on the laws that an agency must follow, the records that it must keep, the reports that it must file, and the training that its employees must receive. At the University of North Texas, a web accessible database was designed to house all of this data and to make it accessible to university administration, faculty, and staff. The information in the database is used both for ongoing risk assessments and for guidance.

Institutional Compliance: Functional Aspects and Information Components

An institutional compliance program is a formal voluntary commitment of a university, a medical school, or a business to conduct its operations in full compliance with all relevant federal and state laws. Effective compliance programs train managers and employees in the requirements of applicable laws and regulations, and they prevent and detect violations. To demonstrate compliance, an organization must keep effective records and file reports with regulating agencies on a fixed schedule. To carry out its purpose, a compliance program must manage large amounts of information and process significant amounts of data.

Implementing a compliance program entails mapping a subset of the universe of law to the structure of the organization. In every unit and department within an agency, managers and supervisors must understand applicable legal requirements. These individuals also must be able to assess the probability that certain violations might occur, either purposefully or accidentally. After completing risk assessments, management must decide how to allocate resources to minimize violations and to maximize awareness of essential legal requirements on the part of employees through appropriate training.

At the University of North Texas, three ODBC databases store information on the structure of the university, the requirements of every applicable law, and risk assessment data provided by individual units or departments. Java servlets create the web forms that generate queries, format the XHTML documents returned by these queries, and communicate with Java applets that are used to edit and manage the contents of the database. The structure of the data in the legal sources database follows a rigorous, yet flexible format that is represented by XML, which permits the generation of cleanly formatted documents appropriate to any type of query submitted.

Database of Legal Requirements

Figure 1 shows the structure of the legal sources database, which represents categories of legal topics and their subtopics. Topics are general descriptions of a body of law (e. g., financial aid regulations) and may include a number of legal sources, which may include federal and state laws, regulations, court rulings, and standards set by professional licensing agencies. The content records of the database provide a general description of a legal topic or of its component laws. The detail records hold specific information on requirements and penalties of individual laws, the records that an agency must retain, and the reports that it must submit to regulating agencies.

Assigning Regulations to Departments

An online compliance administration system enables the compliance officer to assign legal topics or sources from the database to departments. The departments use the assigned regulations for two purposes. First, they form the source set of requirements on which the department must respond in its risk assessment. Second, the summary of each regulation's requirements can serve as general legal guidance and training for department managers or supervisors, as well as for all faculty and staff.

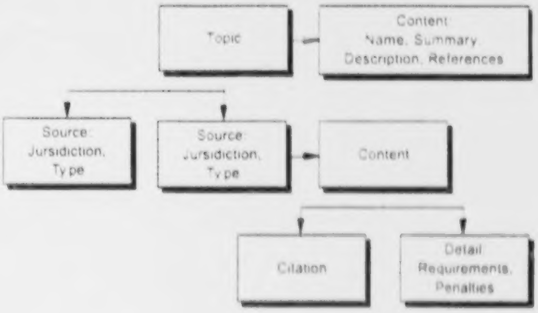

Figure 1. Structure of the Legal Sources Database.

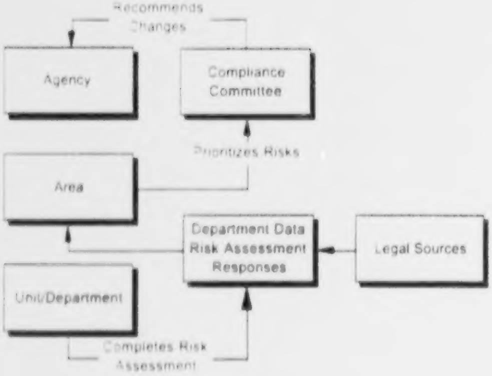

Figure 2. Agency Risk Assessment Process.

Department Risk Assessment

The department risk assessment data enables administrators to identify areas in which the organization might have had a history of noncompliance, or in which an activity (such as working with radioactive compounds) is so inherently risky that the organization cannot afford a mishap. Figure 2 shows the general flow of information in the risk assessment process. Managers review the risk assessments completed by departments and prioritize risks to identify those most in need of immediate action. A compliance committee reviews priorities and the plans for addressing them, and recommends policies, procedures, and training designed to improve the function of the agency.

Departments also indicate how they keep records and monitor risk. The compliance committee and internal audit must then measure the success of the monitoring systems that departments use. The federal government considers compliance programs effective only if they monitor compliance and manage change proactively.

Compliance Assistance

Although the monitoring functions of a compliance program often receive the most notice, the most important contribution that an effective compliance effort can make to an organization is to assist its members in following all the requirements of applicable federal and state laws and regulations.

Training is an important component of compliance assistance. Classroom instruction is often required for topics such as determining the legal tests for discrimination complaints. Other topics, such as research proposal preparation, can be accomplished with online courses. At the University of North Texas, these training options are supplemented by online guidance provided directly from the legal sources database. Faculty and staff can review the requirements that apply to them by accessing their department's help page on the compliance office web site.

Progress of the Implementation and Results

The structure of the legal sources database was modified in the course of this project to accommodate the need of some departments conducting risk assessments for very detailed information on specific paragraphs of laws, while others preferred to review entire categories of law as a single unit. These preferences were generally based on the types of records that a department was required to keep and on the way that it organized its internal records.

Both staff and managers have found the online risk assessment to be a convenient way to assess risk, to review the operational needs of their units, and to set priorities for addressing weaknesses. It also has provided staff with clear information on the requirements of laws that they otherwise would not have had occasion to study.

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Medical Expert Systems: You Won't Work Without Them Once You Know Them

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Abstract: Recent years have seen an enormous development in the field of medical expert systems, making it a time consuming and complicated task for physicians finding the system most capable for them. To give physicians the opportunity to get fast and easy access to a specific system, our department has developed a web site which intends to be a comprehensive source for physicians, students and other health-care professionals in providing information on over 65 worldwide available medical expert and knowledge-based systems.

Medical Expert Systems: Doctor's Silent Partners

Our web page will be a unique collection of over 65 state-of-the-art medical expert systems and knowledge based systems.

An expert system is an Artificial Intelligence program that uses knowledge to solve problems that would normally require a human specialist. Expert systems are one of the most successful commercial applications of Artificial Intelligence and they are used in many different areas. In medicine, expert systems have been developed to assist the physicians in a hospital or in his office in the course of interpreting medical findings, providing diagnostic support and therapy advice, giving hints for disease prognosis, guiding patient management, and monitoring hospital and patient's medical data and costs.

Expert systems and knowledge based systems in medicine help in the manipulation and application of expert medical knowledge.

The growing complexity of the fund of knowledge makes the application of such systems more and more indispensable. The amount of medical knowledge is such that today no physician can access or memorize all the necessary information in his daily practice. Therefore, in an attempt to minimize the incidence of misdiagnosis, physicians are increasingly looking to expert systems to corroborate their findings and/or highlight anomalies and errors. Provided that expert systems are used correctly, they also reduce much of the repetitive and specialized mental efforts made by the treating physicians and enable him to devote his time and attention to the personal care of the patient. Another reason, why decision support technologies are becoming more and more important in medicine is their benefit in cost reduction. For example, expert systems allow the dissemination of information held by one or a small number of experts. This makes the knowledge available to a larger number of people, and less skilled (so less expensive) people, reducing the cost of accessing information.

Additionally, human expertise about medical subjects in question is not always available when it is needed. This may because the necessary knowledge is held by a small group of medical experts, who may not be in the right place at the right time.

Alternatively it may be because the knowledge is distributed through a variety of sources and is therefore difficult to assimilate.

Medical Expert Systems: Struggling for Acceptance

Increasing ease of access to personal computers is partially responsible for the growing interest in medical expert systems. The availability of relatively inexpensive powerful computers is increasing health care workers familiarity with machines, and physicians are ready to accept computers in all areas of their daily life. The World Wide Web demystified computers for many new users by providing the physician with relevant, timely and unique information. As networks have grown and become more robust academics and other healthcare professionals have become to appreciate how they can be used in the process of patient management, teaching and learning.

However, medical expert systems are not yet in widespread use because of the following reason: In recent years a variety of programs designed to assist the physician with drug dosing, health maintenance, diagnosis and other clinically relevant decisions have been developed for the medical market, making it a time consuming and complicated task for physicians finding the system most capable for them. Physicians in Austria, who have been interested in the application of computer-based decision support for clinical medicine, reported the same problems. In most cases, not familiar with the web and using search engines, it was hardly impossible for them to find the right expert system. So thus far the systems have failed to gain widespread acceptance by physicians.

To cope with these needs, our web page will offer enhanced access for health professionals to a wealth of information resources and expert systems, to provide the opportunity to deliver patient care more effectively.

The Purpose of our Web Site

The purpose of this web site is to serve as a comprehensive resource for physicians, students, and other health-care workers in providing information on over 65 state-of-the-art clinical expert and knowledge-based systems. The web site is a unique collection of worldwide available expert systems designed to give physicians the opportunity to get fast and easy access to a specific program.

Physicians are provided with detailed description of the programs, links to the online version (if available), availability, pricing description, clinical use, information about the developer and evaluation statistics. As the web site was primarily designed for physicians, we put the emphasis on medical relevant data and skipped technical details. Special care was taken to provide a logical interface for easy exploration and navigation through the featured expert system. The physician will have the possibility to chose the program he is interested in by name, or decide on a special field and chose from a list of relevant programs. Once the physician selects a program he will have further access to detailed description. Information about the clinical use and the developer can also be recalled. As with the advent of the WWW more and more programs have begun to appear on the Internet (i.e. Hepaxpert, DxPlain, the Heart Disease Program, Computerized Medical Diagnosis), the web site will focus especially on the Online/Offline availability of the featured expert system. Categorization in full version, demo version and Internet version will be given.

The section " Historical Perspective" will illustrate the milestones in the development of expert systems and will give a short overview about the first groundbreaking systems (MYCIN, de Dombals System, Help).

Health care professionals will also be provided with additional background information for like a list of upcoming congresses and events, a link to the Austrian chamber of physicians, and links to other useful international medical sites on the Internet.

The web site will be accessible via our homepage http://www.akh-wien.ac.at/imc/MES

Conclusion

The Department of Medical Computer Sciences of Vienna, which has been developing expert systems for over twenty years, predicts a bright future for the implementation of expert systems in everyday clinical use.

To promote the popularity of such programs, our Institute decided to concentrate as many programs as possible and to make them jointly available in a single source, which hopefully leads to a broader acceptance among physicians.

Building a definitive Online Distance Learning Model (ODL) for a Telecommunication Company

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Abstract: The Online Distance Learning System, called "SEND", comes from the portuguese phrase "Sistema de ENsino a Distancia" and is a multiplataform service structure created to support a new corporate media of education based on Intranet and aimed to a telecommunication company employees. This system proposes a low cost and very easy access educational system. Before launching an ODL methodology, it is very important to consider some aspects of a company internal culture, in order to compose a set of policies that must support the system target.

I. INTRODUCTION

CRT, a recently privatized Telecommunication Company in southern Brazil, is now very well positioned at the global cenary of the competitive Corporations. Considering the highly and increasingly technologies available, it is very important to maintain well-trained people inside the Organization. Independently of geographical position of a worker and without displacement of his job-post, Companies must think about shared and multiservices plataforms to support an efficient and singular educational structure. A constant and well-trained staff constitutes a differential.

II. OBJECTIVES

Educational events available to the employee at any time and any place into a Company Intranet must aim to uniforming information and knowledge to each and every business area. Keeping knowledge in distributed systems is also a very important tool, because it gives the possibility to each expert to share his valious informations.

Incentivating a self-development and reducing job-post displacement can compose conditions to a system that will generate dynamic and multidisciplinar teams. This formula now presented is composed through the increasing of the available informations, with educational quality and for training purposes, focused on the company's business. The differential of a good Distance Learning plan is the development of a new corporative media channel.

Above all, the subject (the person to be trained) must feel as if the training was presential, as he is used to that form of education. So, a new Company culture regarding teaching and learning must be also developed.

III. CONSTRAINTS

There are constraints regarding this project that can be pointed out such as low budget, possibilities of getting free available software and applications. Another challenge is the development of a new culture, made of highly motivated learners, ready to learn over Intranet.

Considering the needed infrastructure, it is important to consider the available Network bandwidth constraints; this is a very important issue, since some limitations like video transmission must be evaluated.

IV. IMPLEMENTATION

CRT Online Distance Learning System started at 1996 with the implementation of a Corporate Television Network called Teleducation. The Teleducation System is responsible for all video transmissions on training matters and events, such as lectures and management address. Classrooms are spread out at the most important cities of Rio Grande do Sul State.

Actually, the Teleducation System is just one more tool that adds up to the CRT ODL Model. This model is fundamentally based on students feedbacks and interactions with the most modern web media technologies worldwide available. The channel for all this development is our Intranet, adapted to the available bandwidth.

All educational tools are composed with the participation of a Comercial Partner that supports contents development as well as systems. Besides, in searching better technologies and new experiences, looking for new medias and Universities, a very interesting environment is generated, increasing the possibilities of having new partnerships with low costs.

Learning Environment		**Online Instructor**
Video Library	**SEND**	**Metropoa/Tapejara Research**
Web TV	**Student**	**Virtual Classroom**
Virtual Museum		**Library Online**

Fig. 2- Systems available to an ODL Student

V. THE SEND ODL MODEL

Before planning services to be offered, or to start up educational servers, it is needed to consider some characteristics that can justify implementation of ODL or not.

The first thing to see in the number of employees to be trained for an specific subject. A very good planning of the contents to develop for an ODL course is fundamental to reach a large number of students even from different job areas.

Taking into account that enough investments are needed in order to create a complete ODL program can make many managers very sad. That is because this kind of development requires a multidisciplinar team for compose the hole system, with lot of time to invest.

Problems with enough training, or capilarization of training hours is a commum problem for most of big companies. CRT is not an exception. As a quality factor for employees, self-development programs increases the satisfaction level. At the same time, though HR training vision must be focused on real training necessities.

Considering this cenary, it was defined actuations fields for distance learning in CRT:

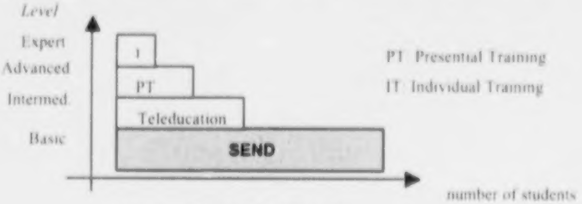

Fig 3 – Send ODL Model

As explained in the figure, SEND contents aims to supply basic contents for a very large number of students. Teleducation System can support na Intermediary level of education, but to a minor number of persons.

Advanced or very particular content is developed mostly presentially, using traditional methods of teaching.

For very special training, CRT recommends individual courses, with a highly graduated expert to develop a special talent of the staff.

VI. APPLICATIONS

A. *Intranet Applications*

A.1. Informatics Training

Informatics is the first course developed at CRT and the most numerous ODL training of this Company. As explained above, informatics is a CRT's Tool Content. So the contents was provided by Smart Force, with the following contents: Microsoft Access, Excel, Word, Power Point, Outlook and Project Management.

A.2.Technology training

As a CRT's Business content, is developed a IP (Internet Protocol) in basic level to support all professional levels of CRT, from technicians to sales departments. For CRT, IP is an strategic content for future applications.

B. Teleducation Training

An important program developed using the Teleducation System is the ECCO (Continued Comercial Education) that aims to solve specific problems of the Comercial area of CRT, with contents focused on Sales Person improvement. Based on a critical indicator regarding juridical complaints against CRT, it was developed this content to supply a Sales Person on rights and duties of the Company, to avoid risks that can increase loss of money.

This course is coordinated by a Costumer Rights Expert Lawyer with course modules developed at Teleducation Studio and transmited all over State. Local activities are developed by a volunteer, that support didactical evaluation and exercises. This volunteers are all specifically trained for this activity on CRT training Center.

C. Hybrid Programs

Some applications need more complex structure to assure good results on ODL. Specifically for a PDCA Training, destined to Sales Person, it is necessary the use of both systems: Intranet and Teleducation. During this program, students are motivated to see the learner on the TV and develop exercices and simulate practical situations using the Intranet. Questions and feedbacks are coordinated by a local volunteer.

VII. RESULTS

SEND already trained about 1000 students, on 12 different development titles. The potential of this system can be seen at the Informatics area, where there is a detected necessity for 150 classmates per month during the year 2000.

CRT is participating also, in a joint academic ODL development with CNPq (Federal Agency for Science and Education Development). The project called "Tapejara" includes two regional universities (UFRGS and Unisinos) and aims to develop inteligent agents for Distance Learning contents. It will create three major titles like a SDH (Synchronous Digital Hierarchy), Basic Telecommunication course and a Business Training Program.

A. *Savings*

The Company saved about 80 % on costs for this same type of training as if it were performed on a traditional basis. People enjoyed this new kind of training since they could take at their most convenient time.

VIII. CONCLUSIONS

SEND, since its start, has showed that technology and education found a commum point to perform good educational methodologies.

With low costs and very easy access, it is simple to compose a system with a great multiplication effect. Above all, ODL must turn out to be fun to learn and the multiplicity of educational agents creates this characteristic.

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Individuals with Disabilities and the World Wide Web: Accessibility at Institutions of Higher Education

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Abstract: The purposes of this study were to evaluate the accessibility of university special education programs' home pages and discuss accessibility recommendations. Eighty-nine special education Web sites were evaluated for accessibility errors. Most (73%) special education home pages had accessibility problems, and the majority of these errors (70%) severely limited access for individuals with disabilities. The good news is that the majority (83%) of the errors can easily be corrected. Recommendations and methods for improving accessibility to the WWW for individuals with disabilities are discussed.

Introduction

In the Individuals with Disabilities Act of 1988 (Tech Act: P. L. 100-407) and more recently, the Individuals with Disabilities Education Act (IDEA: P. L. 101-476) defined assistive technology devices as "[a]ny item, piece of equipment, or product system, whether acquired or commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of children with disabilities (20 U. S. C. 1401 [25], Sec. 300.5). Computers, and related technological advances, represent important assistive devices in the lives of students with disabilities. Institutions of Higher Education (IHEs) represent key public and private facilities addressing accessibility, assistive technology needs, and other concerns of individuals with disabilities and those who live and work with them. The World Wide Web (WWW) is an institutional resource that has revolutionized information dissemination. Accessibility across platforms and geographic distance makes the WWW an ideal universal medium for collecting and disseminating all sorts of information.

While technical developments have enhanced and provided new exciting opportunities for the WWW, they have, at the same time, complicated and limited the accessibility of the content and resources for individuals with disabilities. Web page developers and program directors need to be just aware that on-line barriers can create significant accessibility problems for some users.

The Web Content Accessibility Guidelines 1.0 (Chisholm & Vanderheiden, 1999) is a World Wide Web Consortium (W3C) specification providing guidance on accessibility of Web sites for people with disabilities. The specification includes 14 guidelines, which are general principles of accessible design. Building Web sites that comply with guidelines for accessibility should be a high priority for Web page developers and special education program directors but has received little research. The purposes of this study were to evaluate the accessibility of special education program home pages of IHEs.

Method

A descriptive study was conducted to evaluate the accessibility of IHE special education home pages. The target population for this study was Web pages of special education programs at universities in the United States. A total of 89 special education program home pages were evaluated for this study using Bobby 3.0 (Center for Applied Special Technology, 1998), a free software package that analyzes Web pages in accordance with the W3C's guidelines. Results from this evaluation process provide a measure of the extent to which a Web site is accessible for people with disabilities. Bobbie provides the evaluator with a summary of the type of accessibility error, the severity of the error, and the ease with which the error can be corrected. Reports generated form the analysis of each home page were tabulated and summarized.

Results

Seventy-three percent of the Web pages had at least one accessibility error. On average, there were 4.80 (s = 7.31) accessibility errors per page. The most common accessibility problems were absence of alternative text for all images (54.08%), insufficient information to determine language of text used in presenting information (14.08%), image map hot-spots did not have alternative text (9.76%), and lack of alternative links for client-side image maps (8.32%). The four most common accessibility errors accounted for 86.24% of all the accessibility errors. Most of the accessibility errors (70.72%) were rated as high priority (e.g., highest severity rating). Eighty-three percent of all the accessibility errors were rated as easy to correct.

Discussion

A variety of disabilities can reduce accessibility to the WWW. Visual, hearing, movement, cognitive, speech, and other impairments can limit availability of information and because special education programs use the WWW to disseminate and gather information web pages developed for these programs should address these accessibility issues. Developers of accessibility aids should also continue to identify and develop features that can overcome barriers to accessibility, and there are many things that Web page developers can do, with very little effort, that would make their pages more accessible.

The Web Content Accessibility Guidelines 1.0 provide methods of correcting accessibility errors. One global suggestion for Web page designers is to encode Web pages for meaning rather than appearance. For example, providing alternative ways of obtaining information is a key to overcoming many accessibility errors.

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The Rhetoric of Web Design

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Abstract: Given the highly fragmented nature of the Internet, and the nearly infinite range of subjects covered within the World Wide Web, it's difficult to imagine that Web sites could have anything in common—a characteristic that they all share. But all Web sites do have at least one thing in common: they all represent a means of *communicating* with a given audience. As such, this paper will argue that any Web site can be designed, and its effectiveness measured, by referring to the principles of *classical rhetoric*, a discipline that explores the art of effective communication.

Introduction

Aristotle defined rhetoric as "the faculty of discovering . . . the available means of persuasion" (Cooper 1960). Edward Corbett offers a broader definition: "Rhetoric is the art or the discipline that deals with the use of discourse, either spoken or written, to inform or persuade or motivate an audience, whether that audience is made up of one person or a group of persons" (Corbett 1990).

It will come as no great surprise to hear that rhetoric is rarely studied these days as an academic discipline, at least in the United States. Moreover, it's probably safe to say that the principles of classical rhetoric are not a top-of-mind consideration for those who do any writing or public speaking, whether for professional or academic purposes. Indeed, the very relevance of rhetoric has been the subject of much debate over the years, with many arguing that one can communicate effectively—indeed, that people *have* been communicating effectively—without being consciously aware of the specific *components* of discourse identified by rhetoricians.

Nevertheless, "there is usually a resurgence of rhetoric during periods of social and political upheaval" (Corbett). The rapid and explosive development of the Web as a new means of communication may be considered such an upheaval. The principles of classical rhetoric can serve as a useful framework within this context, helping to guide the efforts of both those responsible for designing Web sites and those responsible for assessing site effectiveness.

Categories of Discourse

A number of authors have explored the ways in which the principles of rhetoric can be applied within the field of advertising (including McQuarrie and Mick 1996). In line with the very purpose of advertising, these authors have focused on a specific type of discourse—discourse to *persuade* an audience to act or believe in a certain way. However, when one is considering the application of rhetoric to Web site design, one needs to consider additional categories of discourse. In addition to *persuasive* discourse (referred to as *deliberative* discourse), Aristotle identified two additional categories: *forensic* discourse (discourse whose purpose is to *defend or condemn* an action) and *epideictic* discourse (discourse whose purpose is to *inspire* an audience).

Web sites whose purpose is to *persuade*—for example, e-commerce Web sites—are among the most common sites on the Internet. But sites designed to defend or condemn, as well as sites designed to inspire, are also common. Although it seems an obvious point, understanding which of these three categories a particular Web site falls into is the first step in determining the overall effectiveness of the site—has it been successful in its attempt to persuade, to defend, or to inspire?

Components of Discourse

Compared with other forms of discourse, the art of Web site design is certainly in its infancy. Also in their infancy are methods for assessing Web site effectiveness. Although a number of Web design specialists have come forward with valuable handbooks to help guide the Web design and assessment process (such as Nielsen, 2000), few hard and fast design *principles* have been established. Moreover, even the broad rules of thumb that have been established have not been widely adopted; Web designers are just as likely (maybe more likely) to develop a site based on gut instinct as on an understanding of what "works" when it comes to Web aesthetics, navigation, or usability.

The development of a set of Web design *principles* needs to begin with some way of breaking down the massive and complex design process into more manageable components—components that can be considered, and focused on, independently. The principles of classical rhetoric can be of enormous help in this regard. According to Aristotle, all discourse can be divided into five components: *elocutio, inventio, pronuntiatio, dispositio,* and *memoria*. For a Web site to be optimally effective, it must meet the needs of its audience in each of these areas:

Term	**Definition**	**Web Correlate**	**Sample Questions**
Elocutio	Style	Look and Feel	Is the site aesthetically pleasing? Is the look and design of the site consistent with (1) its purpose and goals and (2) the image of the site's sponsor?
Inventio	Subject Matter/Topic	Content	Does the site include an appropriate range of content? For an e-commerce site, does the site include all of the information users will need to proceed with an online purchase?
Pronuntiatio	Delivery	Representation	Are hyperlinks effective in describing the associated content—do the link descriptions offer enough information without being too text-heavy? Do icons clearly represent the content/features behind them?
Dispositio	Organization	Organization	Is the general organizational structure of the site clear to users? Can they quickly and efficiently navigate to those sections of the site that include the information they're looking for (and can they quickly return to where they were)? Can users determine where they are within the site structure, or do they have a tendency to get lost in the site?
Memoria	Memorization	Data Gathering/Use of Cookies	Is the site's approach to gathering information about users appropriate given its purpose and users' needs? Do cookies make the process of using the site more efficient? Are there other opportunities to take advantage of data storage capabilities and cookies to make the experience more positive for the user?

Conclusion

The types of design-related questions listed above are included for illustrative purposes only; they should be considered as only a small sample of the range of considerations that need to be taken into account when designing or evaluating a Web site. Moreover, as suggested above, the *principles* themselves are still in the developmental stage and are likely to evolve over time (for example, as broadband Internet access becomes more commonplace). Our purpose in this paper has not been to present an exhaustive list of design considerations, but rather to demonstrate the importance and value of *compartmentalizing* one's thinking regarding Web site design—and to demonstrate how the principles of classical rhetoric can help in that regard.

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Using the Web as a Tool to Bring About Conceptual Change in Ill-structured, Complex Domains

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Abstract: The power of New Media lies in it's capability to present information in various forms to the learner for not only the acquisition of needed information but to allow for new ways of interpreting and understanding the information. This paper explores and examines how to best combine visual and textual information in the context of science education to promote conceptual change. Cognitive Flexibility Theory will serve as the basis for this study.

Introduction

With the advent of fast computer hardware and software for the creation of multimedia and hypermedia, the search for knowledge is greatly accelerated. The breadth, depth and sheer volume of the information to be assimilated are staggering. Another related problem is the complexity of the knowledge itself. This complexity can arise from an unclear or ill-defined body or domain of knowledge. For this study, the specific domain chosen is that of tornado formation. It has been found that this body of knowledge is rich with myths, legends and misconceptions. The categorization of these misconceptions will serve as a basis for the division of subject groups and application of treatments.

Cognitive Flexibility Theory (CFT) focuses on the nature of learning in complex and ill-structured domains. As Rand Spiro, one of CFT's developers states: "By cognitive flexibility, we mean the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands. This is a function of both the way knowledge is represented (e.g., along multiple rather single conceptual dimensions) and the processes that operate on those mental representations (e.g., processes of schema assembly rather than intact schema retrieval)." (Spiro 1992) CFT is especially formulated to support the use of interactive technology. The theory is concerned with transfer of knowledge and skills beyond their initial learning situation. For this reason, emphasis is placed upon the presentation of information from multiple perspectives (themes) and use of case studies. The theory also asserts that effective learning is context-dependent, so instruction needs to be very specific. In addition, the theory stresses the importance of constructed knowledge; learners must be given an opportunity to develop their own representations of information in order to properly learn. (Spiro 1990)

Finally, CFT stresses the network and relationships among knowledge; and involving the learner in the construction of new knowledge via problem-solving tasks rather than the recitation and memorization of facts, concepts, and principles. (Jacobson & Spiro 1995).

The Study

The study begins with the application of a pre-test to determine the current knowledge that the subjects have concerning tornado formation by having them describe and then draw how they think a tornado forms to derive their initial knowledge of the subject matter. After discussion with meteorologists from universities and federal agencies, the main misconceptions were categorized as misunderstandings of the role external or internal dynamics of the phenomenon or believing related phenomenon as actually tornadoes.

The intended audience is comprised of subjects in the formal operational phase of development. Seventy four subjects are grouped based on their apparent misconception and are directed to enter the hypermedia site at a specific entry point. One for each of the misconception groupings and the other for students who don't seem to fall in any group. Subjects who do not display a misconception will be directed to enter a point which allows them to freely browse the site. Via the use of a post-test (identical to the pre-test), their degree of understanding can be ascertained.

Conceptual Changes

Starting at each misconception entry point, the subject is asked their initial understanding of the subject matter and be shown counterexamples to allow them to change or keep their perception intact. An animation shows in detail the sequence of events in the creation and maturation of a tornado as well as case studies and facts to refute misconceptions and enforce proper notions. The subject then takes the post-test. The measure of learning is the conceptual change that has occurred. Of course, this must take into consideration what misconceptions were initially present.

When a student's post-test answers show a tendency towards the true explanation of the phenomenon and away from their pre-test misconception(s), a conceptual change has occurred. Therefore, the magnitude of conceptual change is directly proportional to how much the student tends toward the true explanation of the phenomenon in spite of an ingrained misconception(s). That is, the greater the misconception, the greater the conceptual change as the student tends toward accepting and incorporating the true explanation.

Conclusions

Initial analysis of the results show that while 26.5 % of the subjects still maintained an incorrect conceptual understanding, 40.9% had a conceptual change that moved from incorrect to correct. Additionally, 32.6% of the subject maintained their correct understanding of the phenomenon and most encouraging was that none of the subjects went from a correct understanding to an incorrect one. Additional analysis is being conducted. The usage of CFT-based educational hypermedia seems to not only provide conceptual changes to alleviate misconceptions of tornado formation, but to also affirm initially correct understanding of the subject matter. Further work is needed to see how many different age and ability groups as well as domain types can be helped via this methodology.

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Online Learning Environments: A Health Promotion Approach to Ergonomics

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Abstract: Many professionals who do not live close to, or do not wish to attend classes in traditional universities have embraced computer-based distance delivery methods with enthusiasm. While the Internet does provide greater access to education and does not require people to relocate or give up their jobs, over-reliance on it for both work and school raises many questions and concerns. Electronic course delivery requires students to spend time at their computers in addition to other activities they may be required to do on their computers. Using surveys and focus groups, this study examined the extent to which students studying on-line are aware of and/ or are experiencing physical and psychological risks associated with poor use or over-use of computers.

Introduction

Athabasca University is one of the world's leading open and distance education universities, and as such, it uses a variety of modalities to provide distance education to students around the world. While printed course materials have been the mainstay of the university, there are many courses and programs now offered exclusively on the computer. With the Internet as a readily accessible medium, web-based courses have become increasingly popular with both providers and users of distance education. Many professionals who do not live close to, or do not wish to attend classes in traditional universities have embraced computer-based distance delivery methods with enthusiasm. Electronic delivery enables students to choose the time and place of their learning, and computer conference forums and chat rooms have proven to be highly effective means to communicate meaningfully with their instructors and fellow students.

While the Internet does provide greater access to education and does not require people to relocate or give up their jobs, over-reliance on it for both work and school raises many questions and concerns. Electronic course delivery requires students to spend time at their computer in addition to other activities they may be required to do on their computer for their work. Furthermore, there are both physical and psychological risks associated with poor use or over-use of computers. Some of the common physical concerns identified by Dix et al (1998) and MacDonald (2000) are head, neck, back and shoulder pain, wrist problems from repetitive motion strain, and eye fatigue. Faulkner (1998) noted that psychological effects such as alienation, inadequacy, and lack of privacy may occur. Others have suggested that social isolation, computer stress and phobias can result from over reliance on computers.

Purpose of the Research

While MacDonald (2000) notes there has been some research on ergonomics in the workplace, there has been little research undertaken to investigate the extent to which students experience ergonomic problems related to on-line learning. As providers of distance education, relying increasingly on electronic delivery, we felt an obligation to examine this issue with the goal to ultimately implement health promotion strategies to prevent ergonomic problems. Therefore, the purpose of our research was to explore ergonomic/human computer interaction concerns that students might experience related their on-line education.

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Method

We surveyed and conducted focus groups with undergraduate students taking Computing Science courses and graduate students taking their Master of Health Studies degree through electronic delivery at Athabasca University. Our primary goal was to gain insight into students' understanding of potential ergonomic factors and the extent to which they attempt to prevent or address concerns that could arise. We collected data on their general computer-related habits and their ergonomic awareness related to design of workspace, posture, usage, and exercise. We examined factors and underlying situations that contribute to students being in undesirable physical and /or psychological danger from extended and/or improper use of computers for learning. We also received feedback from students on effective means they have used to reduce the negative effects of computer use, and we received feedback on to best design courses to improve the human-computer interaction experience for students. A description of our research and the results from the surveys and focus group discussion are discussed in this paper.

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Teaching Preservice Teachers how to Use the World Wide Web

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Abstract: This investigation consists of integrating the use of the World Wide Web into an introductory elementary education curriculum course for preservice teachers. The preservice teachers are being prepared to construct interdisciplinary units by effectively using the Web to gather global information. By preparing this unit, preservice teachers will develop a more in-depth knowledge base of different cultures, which will be represented by future students. At the same time, the preservice teachers will be able to increase student cultural/ethnic pride by studying various regions of origin using the Web as a tool to gather current information. The intent of this study is to increase preservice teacher comfort level with computer usage, especially accessing the Web. The Web will be a tool to be used to access resources to be incorporated into the everyday classroom. The intent of these activities is to encourage preservice teachers to become comfortable using computers and the Web for everyday classroom usage. Computers will be thought of as tools, rather than another topic area to be mastered.

Introduction

It is extremely important for teachers to develop techniques that can enhance student engagement and learning. This interdisciplinary unit will not only help students learn about various cultures, but will foster a sense of pride in their identity while using the World Wide Web. It is appropriate to study all cultures with equal respect. All students should learn about their own culture and other cultures, as well as American culture and history. Minority students will be able to see how their cultural heritage is important to the dominant culture of America. This activity is designed to help future classroom teachers acknowledge cultural diversity as classroom strength rather than a classroom challenge.

The unit consists of segments devoted to: language arts, science, mathematics, social studies, music, and art. Using the World Wide Web to break down cultural as well as geographical barriers, students will have access to teacher approved Web sites. Various Web related teaching strategies will be discussed, accompanied by a resources handout. Computer technology will be viewed as a tool to enable teachers to help their students access current information. Computer literacy skills are mandatory for the future. Teachers and their students will need to gather and analyze information employing critical thinking skills to measure the reliability and validity of information obtained from the Web. Working in groups, students will be supported in the learning experience, both academically and socially.

The Study

Preservice teachers were introduced to various computer technology activities in a non-threatening manner starting with learning basic computer skills such as email, word processing, and conducting an Educational Resources Information Center (ERIC) search. These preservice teachers are enrolled in ELED 301, Elementary Education Curriculum. The ELED 301 course is the first course in the professional education sequence. There are no assumptions about prior student experience with computer technology. The population (s=60) of the course is a mix of urban and mainly suburban students, predominately white female, clearly resembling the populations previously studied by (Melnick & Zeichner, 1997), (King, Hollins & Hayman, 1997), and (Goodlad, 1990), nontraditional students (a wide range in ages, typically older than the general undergraduate population), and many first generation college bound. Some of the participants have little familiarity with using computers. Computer fear and anxiety were taken into consideration when designing these assignments. Another factor taken into consideration was the home computer access of some (3) students. A class field trip to the university library is scheduled in the early

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weeks of the semester to familiarize the preservice teachers with resources that can be accessed through the library. One of the reference librarians conducts an ERIC search demonstration via the Web, so preservice teachers can understand this process. For some preservice teachers, this is the first time they have been required to conduct an ERIC search. For other preservice teachers, refinement of skills and new techniques in finding information are emphasized.

After the preservice teachers master the above-mentioned skills, harnessing the power of the Web is the next step in this educational process. It is imperative that preservice teachers be able to gather information about any topic area quickly and efficiently in order to actively engage their students with current resources. Several activities were constructed to help preservice teachers navigate the Web. The University of California Berkeley Library site: Finding Information on the Internet: A Tutotial: www.lib.berkeley.edu/Teaching/Guides/Internet/FindInfo.html is required with evidence of completion handed in to the instructor. An instructor designed Web activity was also given to the preservice teachers via Blackboard.com, an online distance learning structure, so that preservice students will become familiar with using distance learning structures. A paper copy of this assignment was made available in the university library. The instructor demonstrated how to access the site and discussed the various activities involved in completing this assignment. This Web assignment provides a scavenger type activity of Web usage by having preservice teachers locate sites and find information on the Web. The sites listed in the assignment help preservice students gain information about state standards, general information about cultures, as well as information about creating lesson plans. The assignment also helped reinforce lesson planning and the building of the interdisciplinary unit.

The Findings

Students were amazed at how much they enjoyed these activities. According to the post-survey, 80% of the population thought this assignment was a worthwhile learning experience. Ten preservice teachers also admitted to being fearful of computers because they had little or no previous knowledge regarding Web usage. This is a pilot program but it is hoped that these activities and assignment will be extended throughout the entire department of education. Since one of the purposes of these activities is to help preservice teachers acknowledge cultural diversity as a classroom strength rather than as a classroom challenge, the Web usage and construction of an interdisciplinary unit changed some preservice students knowledge base about Africa and Central/South America. The post survey included such open-ended questions as: What do you know about the culture? What is important to know about this culture?, and What is important for your students to know about the culture you selected to study? The presevice teachers surveyed felt that they better understood the cultures that would be represented in their future classrooms. They realized this was just the beginning to better understanding of other cultures. Preservice teachers need to be explicitly trained in multicultural education and in intergroup relations (Banks, 1997 and Slavin, 1995).

Conclusions

This investigation is but one small step to help develop multicultural awareness and respect of diverse populations within a particular teacher education program. The added advantage of using the Web will enable preservice teachers to accumulate current and up to date information available from the culture itself. The authentic assignments and activities caused positive learning experiences for these preservice teachers. It is hoped that these students will model these types of strategies and assignments for their future classrooms using computers to aid their task.

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An Experience of Communication Management for an European Transnational Partnership

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Abstract: New Information Technologies have big potential for improving the communication processes throughout a transnational partnership. However, a Communication Manager, that handles and coordinates the communication mechanism, can greatly improve the overall communication process. An experience of Communication Management for a European partnership has shown that, despite a common belief, using an effective ICT-based communication environment still requires specific competencies, skills and attitudes that are not so common in the emerging Information Society.

The Italian National Research Council, Institute for Educational and Training Technologies (CNR-ITDF), is part of an Italian consortium that submitted a R&D project in the framework of the European ADAPT initiative in 1997. The consortium joined, at the end of the year, a transnational partnership called Neeps (New Eco Enterprises, Products and Services), as required by the European Commission in order to create effective synergies between European projects. Neeps included 9 projects in 5 European countries; actually, each project involved local consortium of partners, so that the number of real partners was 20. The partnership involved a diverse range of professionals: human resource development consultants, vocational training agents, research and educational institutions. Since the constitution phase, it was clear that electronic networking could effectively support the communication and reporting mechanisms for the partnership. However, the constitution mechanism for the transnational networks in ADAPT caused three important factors in Neeps: no partner knew each other before the start of the partnership; there were technologically oriented partners mixed with non-technological ones; common objectives were identified between groups of partners, but not for all the partners. This was a consequence of the general ADAPT partnership establishment procedure: projects are submitted on a regional or national base and it is not so easy to find projects with similar aims; then, since most of the partnerships involve several partners some of the projects could be not strictly related to the others; ICT knowledge and skill can greatly vary in the partnership; finally, the Commission does not perform any control on the aggregation process of a partnership. All these aspects can be obstacles to the communication activity in the partnership and, as a consequence, to a real and effective synergy amongst the partners. The role of the Communication Manager (CM) can greatly improve the overall communication process. The CNR-ITDF acted as CM for Neeps, and this experience is reported in the paper.

An integrated reporting and communication mechanism

Since the beginning of the Neeps transnational network, it was agreed to distinguish between the different needs of communication, public outreach reporting and co-operative work, since each of these activities requires specific interaction modes, is aimed at different target groups, could require processes of communication of different complexity, and so on. Specifically, it has been possible to identify the main requirements for Neeps: Public Outreach activities aimed at reporting towards the outside world; communication within the partnership; communication and cooperative work within individual Focus-Groups (3 groups were established in Neeps, each aimed at affording a specific aspect of the more general objective of the whole partnership); transmission of the Focus Groups results to the partnership; debating about topics of common interest; exchanging documents.

The ICT, that were easily accessible by all the partners of Neeps (even though at different levels of knowledge), offered several important solutions for such requirements. Since a choice had to be made from the many existing ICT tools, the CM focused on five systems that were already used by some or all the partners: a number of mailing lists to exchange general information, announcements and short communications on the whole partnership or on the Focus Groups activities, strategies, difficulties, and so on; a Web-based discussion area to discuss subjects related to environmental problems; a Web-based cooperative work environment, BSCW, a *shared workspace* system which enables collaboration over the Web and supports document upload, event notification, group management and much more (Bentley et al., 1997); the "Neeps" Web Site, mainly for Public Outreach purposes; E-mail for private communication.

All the communication, reporting and cooperative tools have been made accessible through a unique access point, the Neeps Communication Services Home-Page (http://www.itdf.pa.cnr.it/neeps/indice.html), and they have been integrated with each other, through links between the different tools.

The lesson learned

The Communication Management of the transnational partnership has been evaluated through a continuous monitoring of the communication processes, a direct face-to-face feedback during the joint meetings and, finally, through a formal evaluation at the end of the second year of activity.

The selection of a minimum set of communication and cooperative tools, according both to the real needs in the partnership as well as to the technological expertise of the partners was the first major problem to be addressed. Actually, the availability of many solutions and environments on the Net, that enable a variety of communication and cooperation modes, contrasted with the technical expertise of some of the Neeps partners. Indeed, a single non-technical member in a group of technical experts greatly reduces the possibility of including really complex communication tools as well as a great number of tools. Even though only five communication and cooperation environments were eventually selected, members of the partnership have shown difficulties in understanding when to use each tool. Therefore, the CM provided the following support: the distribution of a "summary table" on the use of each tool; the activation of a single entry point to all the Neeps services; the provision of practical guide and support for each tool. To this aim, a contact person for each of the communication and co-operative tools could be reached by every partner. It should be noted that the reported problem concerned the use of the tools in the right context, rather than the complexity of the tools. BSCW, that is an extremely powerful cooperative work tool and implies the longest learning cycle amongst the five solutions, was used on a regular basis by most of the members in the partnerships, and to perform most of the remote co-operative activities.

A second matter with the communication mechanism was that people did not connect to the remote systems (BSCW, the Neeps Web site and the Web-based discussion system) on a regular basis, due to the fact that uploading of new information or messages into these systems was not on a daily basis. As a consequence, people could ignore the presence of new information in these remote systems, with long delays in the activities. On the contrary, since the mailing list is based on the Internet e-mail, and therefore it is not necessary to access a specific site, information and announcements sent through the mailing list were received with minimum delay; as a consequence, it revealed much more effective than the other systems as far as the information acquisition delays are concerned. In order to overcome this problem, the CM encouraged people to use the mailing list also to communicate events occurring in the other communication services (the publishing of a new section in the Neeps web site, the uploading of a new file in the BSCW workspace or the beginning of a new discussion thread in the web-based discussion system). In this way, it was easy to cut down the delay between the upload of new information and people getting it. Consequently, the mailing list can be considered as cross-related to the other communication services. On the other side, people feels uncomfortable with long silence periods on the mailing list, starting to wonder if the mailing list server works properly, or if they have been removed from the mailing list. Therefore, it was decided to send "void control messages" every week, in order to make people ensure on the correct working of the listserver. To conclude, we can say that the role of the CM that handles and coordinates the communication mechanism by selecting the ICT solutions most appropriate for the partnership, encouraging the collaborative activities and so on, can greatly improve the overall communication process.

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Creating IMM and Dealing with Subject Matter Experts?
An Approach that Works

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Abstract

By asking two, easy to understand questions and controlling the role played by a subject matter expert, instructional designers are able to produce quality interactive media products without experiencing problems so typical of working with subject matter experts. The questions asked of subject matter experts readily help determine course content and identify course objectives, exercises and evaluation strategies without training a subject matter expert in instructional design.

The Setting

Prominent in range resource management, Professor Howarth teaches Environmental Science at State University, serves on three university committees, five college & department committees, manages a funded research project and teaches one undergraduate and three graduate courses each year. He typically supervises three theses and two dissertations. One or two paper presentations and two articles a year are combined with his work on an undergraduate textbook. Professor Howarth agreed to an interactive multimedia (IMM) courseware development project because he wanted to be involved with newer media, because of the honorarium – and because he didn't understand what would be required of him.

The Consequence

Professor Howarth quickly learned that he didn't have the time to create materials with the rigor and attention to detail demanded of carefully considered, interactive courseware and fell woefully behind. He was confused by the 'empty educational jargonese' and became frustrated by the 'picky' critiques of what he was providing. His real priorities – research, teaching and publishing – took precedence as the developers 'hounded' him for needed content. He promised himself to *never* be involved in such a project again!

From the developer's point of view, it seems that the more qualified a subject matter expert, the less available he or she will be in terms of her time, interest and the developer's ability to attract and hold her attention – to maintain her commitment.

How best to Use a Subject Matter Expert?

As designers and developers of interactive media content we have two options for developing content with working with subject matter experts (SME); to develop the content by 'training' the SME to be our principal writer, or by limiting his or her involvement though carefully define roles. In this latter option the SME provides direction, checks on content accuracy, currency and fidelity while the designer or developer designs, writes, re-writes, tests, and re-writes.

The "Two Question" Approach

Our experience has taught us to control SME involvement by asking two, simple questions, "What content are you covering?" and "Is there a situation in real life that each student should be able to handle using content X?" When you ask the first question, "What content are you covering?" it is a question understood by faculty who typically provide items like; a course outline, the current syllabus, a list of assignments, the textbook, exams and quizzes. You go away with those resources to digest what you've received. From your analyses of that content, and a focus on what is expected of the student, you select integral, separate 'pieces' of content and return to the SME to check your understanding. Aa a part of this next step you ask the second question, "Is there a problem in life that a student should be able to solve using content 'x'?" and from the SME's responses you will receive, if you're looking for them, much of what you need for the instructional design.

Your next step is to go away and simply 'recycle' what the SME gave you, in more formal, instructional design terms. You take the SME's responses to question two and turn them into goals and objectives, practice exercises and assignments, evaluation strategies, and a more accurate view of the content structure, scope & sequence.

An Example

Let's return to Dr. Howarth's "Range Management" Course. From asking the question, "What content are you covering?" he hands you the syllabus, textbook, and a course content outline. As you analyze these you notice what appear to be critical concepts, "range site," "range condition," "suitability," "succession" "climax" and "trend." You return to Professor Howarth, and ask, "Given the concepts of 'range site', 'range condition' and 'suitability', is there a problem in real life that students should be able to handle?" He says, "Of course." "They must complete range analyses to describe the range condition from its plant community and status. This they do by performing a transect of the site, listing and quantifying plants and their condition according to accepted norms. The transect results in a suitability index." From those answers you now have the objectives, practice exercises and evaluation for those concepts. You've also discovered a new tool, a transect, and ask how that is performed.

In this approach the roles are carefully delineated and controlled by you, the designer. The subject matter expert provides initial direction to the course, is the principal resource, serves as a 'sounding board' and expert who checks on accuracy, currency, completeness and priorities of content, exercises or other experiences. The instructional developer collects information and related resources, analyzes SME-provided content to formulate goals, objectives, exercises and evaluation, designs course structure, content, sequence and strategies, locates and manages funding and other support, and administers those resources, especially the team personnel.

Of course, others are needed on the team besides the instructional designer and the subject matter expert. Writers, media professionals (including directors, cinematographers, etc.), data entry clerks, programmers, evaluators, graphic designers and others are likely resources.

Advantages to this Strategy

The advantages to this strategy are probably obvious.

You take professors where they are. 1) Professors understand the questions you ask and do not need training in a process or jargon; 2) You ask for what they're already used to providing; syllabus, textbook, content outline, exam; 3) You focus on their typical perspective – the content; 4) You don't train professors in writing objectives, system analysis, software tools, etc.; 5) You don't use 'educanese', a language of no substance to many.

You support professors while keeping a low profile.. 1) You collect and reflect what they know; 2) You don't train them so you don't threaten; 3) You don't have to be critical of their work; 4) You don't have to re-do what they provide; 5) You aren't forced to accept the work, as-is.

You control the work and timing. 1) You do the formal work rather than training someone else to do it; 2) You have the time and the motivation – you're hired to do it; 3) You benefit from the professor's expertise with fewer quality and deadline headaches.

You control the content, assignments and quality. 1) Since the course is tied to reality and expectations of students in a real-world setting, you can improve its quality. 2) You can see that: content matches the objectives, the evaluation matches objectives, the scope and sequence of the course flow reasonably, prior knowledge is not assumed, and that there is less chance of holes existing in the content, assignments or other course experiences.

Summary

By asking two, easy to understand questions and controlling the roles played by subject matter experts and instructional designers, you can produce quality interactive media products. The questions are, "What content are you covering?" to determine the content scope and sequence; and "Is there a situation in real life that the student should be able to handle using this content?" to identify the objectives, exercises and evaluation strategies.

Just the FAQs: Bullets Versus Knowledge in On-line Courses

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Abstract: Many colleges have scrambled on-board the on-line course bandwagon. Face-to-face courses are quickly commuted to on-line courses without consideration as to what might be the repercussions of those transitions. World Wide Web (Web) management courses attempt to collect content material and hurl it on-line at breakneck speed in order to be competitive with other universities, vying in the same on-line race for students. An address of some common mistakes currently occurring in the creation of on-line courses and how on-line courses can avoid these mistakes must occur. More importantly, a discussion surrounding how on-line courses can focus on contributions to the body of knowledge and assure that on-line courses contain more than mere content bullets must be addressed.

Introduction

The research collected by a team of instructional designers at the University of Houston - Clear Lake supported the findings that there were no significant differences in the grades of students who took on-line courses from traditional classroom students (Hirumi, et al, 1999). The fact that on-line courses did seem to meet the demands of an increasingly mobile and technological group of global students certainly seemed to support the increased use of on-line courses, regardless of whether or not the quantitative research supported this increased usage. However, the design team discovered important aspects within the review of existing on-line courses and review of existing research. The team suggested that there were important elements of on-line course design that seemed to be missing from many of the current on-line course programs. A suggested, significant gap that seemed to exist concerned the creation of a systematic design for on-line programs, not just random course development within program areas. It was suggested that a standard of excellence needed to be established that would not only address the content of the on-line courses, but for the entire program of courses as well as the factors that influenced entire program. The team members emphasized their individual areas of interest, which could potentially have a profound influence towards the body of knowledge pertaining to online education.

"Soft Skills" Integration

Research conducted on the societal, economic, and every day influences of students that are often not included within courseware design considerations was highlighted. Research into semiotics, tool mediation, and technology integration of sociocultural influences reflected strong affects on learning that must be taken into consideration when designing courseware (Salomon, 1997; Eisner, 1997; Gannon Cook, 1998; Jonassen, 1999). The careful design and development of a distributed learning environment in which the technology plays an integral, yet superfluous role, in the learner's knowledge acquisition suggests the flow of the courseware design must be not only user-friendly in its design but also in its implementation. The inclusion of metaphors within the courseware design accomplishes the desired outcomes, due to the integration of the learner's previous knowledge base, also referred to as conceptual framework of understanding, and aids in the acquisition of new knowledge within an appropriate schema. The distributed learning environment must offer mediation between the technology that has been appropriately integrated into the design of the course as well as the sociocultural influences that must be taken into consideration within any appropriate, successful learning situation.

State Assessment Standards Integration

Research conducted on the impact of assessment standards, such as the integration of the Texas Essential Knowledge and Skills (TEKS) standards within the online course assessment system, on the design of on-line courseware was also significant. The findings reflected that the integration of the TEKS standards within the online course assessments reinforce learning, but these assessments also prompted the integration of "thicker" content integrated into the courseware design (Gannon Cook, 2000; Hirumi, 1999). As suggested by the qualitative conclusions drawn from the integration of the TEKS standards within the online course design, development and implementation, the thoughtful integration of state assessment standards within an online course environment emphasizes the strength and productivity that may be drawn from such partnerships; an online course may be strengthened and benefit from the use of appropriate assessment standards.

Conclusions

"Soft skills" and state assessment standards integration within a distributed learning environment emphasizes the use of numerous levels of instructional design, development and implementation through that may benefit the systematic design of courses within a program of study. Graphics had a higher impact than had originally been suspected, but additional research must be conducted as to whether these findings suggested statistical significance to a larger extent than researched herein. The instructional design process that enforced the inclusion of narratives and inscriptions suggested the positive impact on student learning; however, additional research must be conducted to discern whether or not these factors were significant in affecting students' future online learning experiences. The suggestion that assessment standards reinforced learner knowledge acquisition and integration within a conceptual framework, while research supported the findings, suggests that additional research within these areas must be conducted. The area of courseware design that was designed to accommodate specific requirements like those of the Texas Essential Knowledge and Skills Assessment (TEKS), as well as other state and federal guidelines such as International Society for Technology in Education (ISTE) and the Association for Educational Communications and Technology (AECT), must be further researched. Further research into these areas may reveal the impact of factors such as software, graphics, narratives, and soft-knowledge factors, like test content material, and how these factors could be more effectively integrated into courseware design.

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The Evaluation Issues arising from the Implementation of the School of Art & Design INTRANET at Staffordshire University.

A Brief History of the Intranet Implementation
The vision and specification of Staffordshire University School of Art and Design's Intranet originates from 1994 when a clearer picture of the implementation technology emerged. The School's need was to develop a user-orientated system to support the delivery and administration of Art and Design Higher Education. The School saw intranet technology as the first real hope of implementing a paperless office, in fact a mini-"Docuverse" as Nelson (1974) would describe it. This Docuverse needed to be more accurate, up to date and archival than the existing paper based systems, particularly as these were based on the extensive and uncontrolled use of floppy disks and word processing. It also had to incorporate information management and on-line information services for students, academic staff and administrators as well as being a supportive and effective learning environment.

Issues affecting implementation
A number of major environmental (in the educational sense) issues had significant influence on the Intranet's implementation. Firstly, as student numbers rose dramatically during the 1990's so did the number of student appeals and litigations. This has made the need for traceable, version controlled and up to date information much more important and immediate eg date identified versions of course documentation; module versions in force in any particular academic year.

There have also been a number of unexpected drivers during the Intranet's development period. In particular, the introduction of the recharging of "photocopying" costs - encouraging course leaders to "save" their precious budgets by using the Intranet to publish a wide range of materials to 100 or more students at a time. The School administrators need to save their copying costs when providing the large sets of documents needed to support the students "reps" on the Course Advisory Groups.

Work outstanding is to convert the remaining handbooks to the revised specification on-line format; translate the remaining of the modular descriptors from word processor files to on-line database format; and install of additional student browsers.

On-going evaluation
The user-community "effectiveness and satisfaction" evaluation of the Intranet is ongoing. Action research methodologies (Cohen & Manion, 1989) such as focus groups and user questionnaires are utilized and these encompass all the Intranet's user communities: academic staff, technical staff, administrative staff and students.

The underlying methodology for the design and implementation of the Intranet has been "prototype-evaluate-revise" with repeated iterations of the "revise-evaluate" cycle since the prototypes initial introduction. The components and the information design strategies used are continuously refined in response to feedback from our wide range of "information customers" - staff, administrators, technicians, students and the "external reviewers" of the Quality Assurance Agency.

There are so many elements in the Intranet it is not practicable to isolate individual components for detailed evaluation and analysis as all the elements support (or not) each other in complex ways eg the size of a font may work in the majority of situations but not in one key area. Feedback from the various user sources (questionnaires, Course Advisory Group action lists etc) is tabulated and analyzed for consensus views and critical hot-spots: see table 1.

Feedback from students is gathered via two routes: the Course Advisory Groups with documented and traceable actions points as well as the end of module and end of level questionnaires.

The students' main issue is the printing costs of materials from the Intranet. This off-sets School costs onto the students but is now unfortunately unavoidable. Yet students are surprisingly reluctant to adopt a "screen based information culture". They state again and again that they are not willing to read long and complex documents on the screen. In tests with students the use of Adobe Acrobat versions of large documents was found to reduce their willingness to engage with the material; despite Adobe Acrobat's dedicated on-screen reader support features. Students are also unimpressed by the inconsistencies in Acrobats printout abilities.

Students report that the "studio browsers" go some way towards alleviating this attitude because of their convenient location and availability but not entirely. They also report that their ideal is to be given a laptop with wireless access to the Intranet. Though not affordable currently, this is something that will have to be given serious attention in the future and is predicted in the Dearing Report.

Other feedback includes: the need for visually attractive - high quality typographic design given the visual sensitivity of our users; the need for greater quantity and availability of student browsers (currently at 1 per 30 students); and the speed of data transmission to the "studio browsers" ie the supported bandwidth.

Feedback from the academic staff is gathered via staff team and course leaders who use informal groups, the School's Computing Policy and Operational groups and the School/University liaison group to note successes and concerns. Feedback from administrative staff is via the similar routes whilst input from the technical staff and "learning support technicians" is via the Course Advisory Groups.

Student user questionnaires highlight the need for accurate and up-to-date information above all other issues (85% referring to dissatisfaction with the current paper based documents and publishing methods); overall satisfaction with the Intranet to date is rated at 58% for all users.

Key issues are the broadcasting of Frequently Asked Questions (FAQs) in support of the specialist workshops; working with strict guidelines for file naming and disciplined filing so that a universal conceptual and navigation model is owned by all who use it and work with the Intranet; the interface between the School and the University at both hardware and network management levels; the hosting of student webpages and the complex issues involved including branding (eg the corporate name and associated presentation and other standards) and the copyright of materials); and additional staff and student training and support.

Conclusion

The evaluation conducted to date indicates that there is no alternative to the intranet approach in the current higher education environment and that when an intranet is of such a large scale that evolution is the only design strategy that can be sensibly be employed.

The importance of liaison with the users (and in this case there are a large number of distinct types of users) cannot be stressed enough in the development. Whether they can all be equally served operationally we can only report at a later date when further feedback is available from the whole School community as the system and the users mature.

Finally, one issue that will clearly become increasingly more important will be how student participation, ownership and democracy are enabled (or not) in these intranet based Docuverses. Our Course Advisory Group experience leads us to believe that student participation backed up by a fully functioning and mature intranet could effect real change in the conduct and operation of higher with real collaborative and resource based learning - challenging concepts such as plagiarism, individual submission, multimedia presentation assessment, availability of resources and acceptable service level definitions.

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A Step Beyond Authoring: Process-Support Tools

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Abstract: In order to keep the design and development of Web training and information projects in the hands of trainers, writers, and subject matter experts (SMEs), many companies have invested in HTML authoring tools of one form or another. The goal of such tools is generally to allow people without programming skills to produce Web pages. We argue here that such tools address only a small, isolated piece of the problem. Instead, technology should support the full, collaborative development process, in an integrated manner which incorporates authoring.

1. Introduction

As the Web has become increasingly popular, companies have scrambled to put their internal information and training on their intranet. In order to keep the design and development of such Web projects in the hands of trainers, writers, and subject matter experts (SMEs), many companies have invested in HTML authoring tools of one form or another. The goal of such tools is to allow people without a programming background to produce Web pages and Web-based training, and to that end these tools often succeed to some degree.

Yet such tools are addressing only a small, isolated piece of the problem they're being used to solve. Particularly in large companies, the process for getting information or training to an approved, publishable stage, is often complex. Designers, subject matter experts, writers, editors, and an approval committee often play a role. Even if only one person is involved, the complete design, development, and revision process can be complex. Authoring tools to this point have assisted only in technical implementation (Guralnick 1996). We argue here that technology can and should play a key role in supporting the overall process, and we outline the architecture for a "process-support tool" that does so. In this paper, we use the content-updating process of a Web site as our sample case; we believe an extended set of tools could support the design and development process of a new piece of software as well.

2. An Example: Updating a Site

Consider a large retail chain with over 1000 stores, which needs to build and update a Web-based information reference for their store managers (Guralnick & Larson 2000). Within the organization, many topics have specific experts—there's an expert on operating the cash register, an expert on leadership and development, etc. Once a Web site has been created, the process of determining what content requires updating; ensuring all relevant subject matter experts and higher-ups participate; and making, implementing, and distributing changes is a difficult process. The process involves a substantial amount of collaboration and data tracking as well as technical effort. In order to complete any version update and release it to the target audience, regardless of the deployment medium (paper, Web, etc.) and group involved, several related tasks need to be completed. These include the *determination of what changes need to be made in each area; writing; editing; review and feedback; implementation (e.g., HTML coding, artwork, scripting); testing/quality assurance; and release.* In practice, many of these tasks are done several times, iteratively, before a new "release" is completed. In our retail example, several different content areas may require updating, the cycle of writing, editing, and reviewing may need to iterate several times for any particular page, and content may change rapidly. Today's authoring tools address only the "implementation" task at best.

3. The Case for An Integrated, Process-Driven Approach to Tools

The creation or alteration process for a software system, even a simple one, is generally somewhat complex. As we've seen above, such processes as collaboration with others and tracking open issues can be time-consuming and error-prone. The tasks involved—writing, integrating feedback, implementation, etc.—in creating or updating a piece of Web-based training or a Web site often overlap, and are closely related. An integrated approach to *process-support tools*, in which implementation is treated as only one piece of the puzzle, can provide the following benefits:

- *Improved efficiency*: notes, feedback, SME contact information, etc., are all easily accessible in the same place, leading to faster, easier work.
- *Improved quality*: the technology-based tool offers automated features to catch and prevent errors, and allows users to offload data-tracking tasks to the tool, letting them concentrate on the project, rather than the process.

4. Tool Architecture Overview

The process-support tool architecture as we're developing it consists of three primary components. Below we briefly describe each component along with the tasks it supports.

Development Center: End-product code, Indexing, Review Notes, Note-tracking

This section of the tool supports page authoring with a content-based, WYSIWYG interface, but also integrates several other process-support features. The Development Center includes the following:

- *Site Editor* – this allows the user to view and edit pages in the site, and can display them in several ways: display types include visually (as a chart or diagram), alphabetically, by content area, and by SME;
- *Page Editors* – The centerpiece of this screen is a simplified WYSIWYG editor in which built-in templates can be used. Common word-processing features, such as bullet points, paragraph spacing, and tables, are designed to work the way they do in word processing programs, without any need to "think" in HTML. Data associated with each page includes the date a page was last changed; the date a page was last uploaded to the Web server; the author's notes; the status of any review or feedback on the page; and the SME(s) with contact information. An author can also "Preview" a site, starting with any page, even before uploading it to a Web server.

Collaboration and Reporting Layer

Paper or online reports can be generated, in any combination the user prefers based on several criteria, including each page's content area, review status, change dates, subject matter expert(s), or the appearance of a word or phrase. Paper reports can be useful in collaboration, or for the user to review.

Developer's Toolbox – Support Tools

This layer of the tool helps ensure quality and consistency, within a site and across sites. These features include spellcheck; find/replace; a shared style repository; and automated testing routines to prevent missing links.

5. How it Works, in Practice: An Example

For the retail store mentioned above, one person, the "point person", has the following Web site responsibilities:

> *Contact the SMEs to determine what content needs to be changed; Implement the changes; Ask for feedback from the SMEs and sometimes others; Finalize and test the changes; Release the new pages.*

The point person has been intentionally selected for her skills as a writer, thinker, communicator, and content organizer, rather than as a technical expert. The process-support tool helps her revise, implement and deploy the site. She can, using the tool, compile reports for SMEs, send out pages for review, with questions (automatically via the Web; the reviewer can look at the actual page accompanied by reviewer-specific questions, and respond via the Web), and track all notes and feedback. When ready, she can release the updated site to a production Web server. At any time, she can review any part or parts of the site, in any combination she prefers.

6. Conclusion

The rush to put training and information on the Web has focused tremendously on technical implementation. In many ways this is natural, since the technical side is both the most mysterious to many people, and also has the most noticeable consequences if it doesn't go smoothly (e.g., if the software fails to work). Often lost in all the rush to simplify the coding process is the need to design useful technology that helps an audience achieve its goals. Today's authoring tools reflect today's implementation-oriented approach to technology. An integrated, process-based approach to using technology can smooth the entire development and revision process. "Process-support" tools can decrease the cost of producing and deploying Web-based training and information as well as improve its quality.

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Project EDUCAR: a Distance Learning Project Implementation

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Abstract: Distance learning is a powerful tool to bring the education to those who have no means to achieve it. This article describes the modeling and implementation of a distance learning course on basic mathematics. The audience of the course are high school students and teachers. We describe the guidelines for user interface definition, database modeling and course management. The model is designed to be made available on high speed networks using multimedia resources and non imersive virtual reality.

1. Introduction

Today our society is in the middle of revolution with the new communication methods. Information is no longer a wealth that resides in one place only, available for a few research groups, it is becoming available for those who need it their work environment.

Project EDUCAR (To Educate) was born in the most critical stage of this great revolution that the Internet brought to the dissemination of the knowledge. Our main objective is to fill a hole, taking advantage of the possibilities the web brought to us, modeling and implementing distance learning courses within an emerging country (Brazil).

The justification for the project implementation is that several institutions are searching ways to build and implement distance learning environments. The local context of the project study and implementation is also another justification. We live in a society of irregular wealth distribution. Brazil follows the typical picture of a third word state, with poverty, lack of jobs and learning opportunities. With this study, we also desire to bring knowledge to those who wouldn't have the opportunity to achieve it. The project relies in high technology, fast network connections, most of the country is already linked with fiber optics making it feasible to be implemented.

Finally, the objective of this document is to give a brief view of the project, on its stages of modeling and implementation, and the impact expected in our society.

2. Designing a Distance Learning Model

The design of the management model uses tools and concepts from the structured analysis theory, including the Entity/Relation Database Modeling Theory (ER model) and Process Design Theory using Data Flow Charts (DFC).

3.1 Database Modeling

Any distance learning system relies on database to store the courses, control access and keep track of students activities. The first step in the database modeling is to determine the ER model to be used in the system, respecting the needs and constraints imposed in its concept. This model abstracts implementation details, but will embrace the main structure of the data to be stored. The main structures in this model are the entities, which describes real entities in our world, and the relationships, that unite these entities and provide the meaning of the interactions among them.

The main entities in design are the student (enrolled in a course) , course , teacher, test (used in assessment) and page (details of each html page in the database). The full ER model is available in our home page (http://www.inf.ufg.br/Eduardo/educar.htm).

3.2 Process Modeling

The implementation of the system depends on processes available to students and teachers. The processes modeled to the students are: register student on system, register student on course, visualize course and answer test. The processes modeled to the teachers are: register course on system, register page to a specified course and register test to a specified course.

This related processes use html forms to interact with the user. The filled forms are treated by a script language code embedded in the html pages. Scripts such ASP or Pearl/CGI, are server-side executed and the client will see only html text.

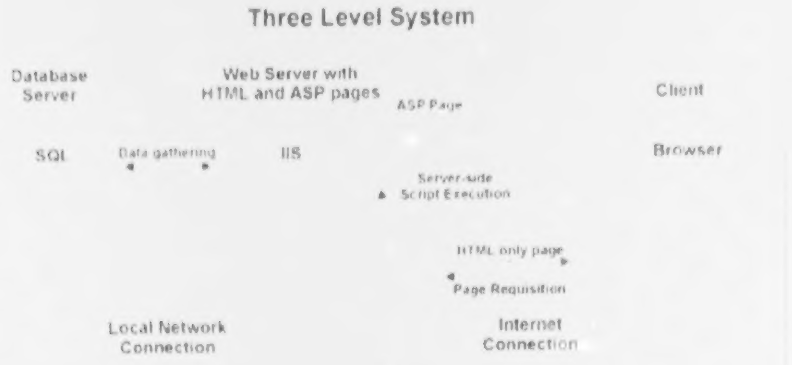

Figure 1 *Server-side script execution*

In this model, we can see three levels of execution: the client level, the web server level and the database level. The client requests the html/asp pages, the script is executed on the web server and the result of this execution is returned to the client in html code. The client side does not know about the existence of the embedded script code in the page (executed in the server). The database level exchanges information with the web server level in the execution of the script, and there is no direct communication between the client and the database.

3.3 User Interface

One of the guidelines projecting the user interface was to provide a look and feel that students are familiar with. Therefore, the interface follows a popular structure among the developers of tutorials and help documents in the Internet: the two-sides frame structure in the browser. In the left side, the topics of the course, including its chapters will be posted. In the right side, the student will be able to visualize the main content of the course.

The exemplification of the content requires a more complex interface due to its importance in the learning process. At this point, the study of tools for exemplification process that happened in the beginning of the modeling will be justified. The VRML (Virtual Reality Modeling Language) embedded in the pages, together with the Shockwave animations resources will grant the success of the exemplification process.

The interaction between the students and teacher happens in two ways: by chatting in the chat rooms provided by the system (real time interaction); and by email (asynchronous communication).

6. Conclusion

This distance learning study is mainly oriented to a real word application system and is the main part of my final computer science course project at the Universidade Federal de Goiás (UFG). The aspects of its modeling and implementation are based in a database and system analysis study during this course.

Feedback is welcome at my email address: gjardim@inf.ufg.br. See further information at http://200.137.192.200/

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Social Desirability Responding on World Wide Web and Paper-Administered Surveys

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Abstract: Social desirability responding (SDR) on surveys administered on the World Wide Web (WWW) and on paper was examined using 178 graduate and undergraduate students randomly assigned to a 2 (survey's administration mode: WWW and paper) × 2 (participants' identifiability level: anonymous and non-anonymous) true experimental design. The findings reveal no differences in SDR between the WWW and the paper-administered survey conditions, and no differences in SDR between the anonymous and non-anonymous conditions. These findings and potential explanations are examined for consideration by anyone interested in using the WWW to obtain accurate information from survey participants.

Introduction

A prominent form of response bias is *social desirability responding (SDR)* (i.e., the tendency to provide answers which cause the respondent to look good) (Rosenfeld, Booth-Kewley, Edwards, & Thomas, 1996). Recently, the proliferation of web-based and other computer-assisted means of acquiring information from individuals has raised concerns regarding how responses obtained through computers compare with responses obtained on paper instruments. Several published studies (see Booth-Kewley, Rosenfeld, & Edwards, 1993; Moorman & Podsakoff, 1992, for reviews) have reported that computer responses are more candid, less biased, and less influenced by social desirability than responses given on paper. However, very few studies have examined people's responses on the World Wide Web (WWW). Furthermore, several research efforts have failed to replicate the findings of previous studies regarding SDR. Based on previous research suggesting that computer-administered surveys yield more candid responses than do paper surveys, this study hypothesized that adult students taking a survey on the WWW would demonstrate significantly less SDR than would students taking the same survey on paper. Furthermore, based on previous research suggesting that participants would be more inclined to respond to survey items under conditions of anonymity, this study hypothesized that adult students taking the survey anonymously would demonstrate significantly less SDR than would respondents who were asked to identify themselves.

The Study

178 undergraduate and graduate students at a large university in the southeastern United States, enrolled in introductory research and technology courses, participated in this study. 69% of the participants were female. The average age of participants was 34.2 years.

To assess the extent to which participants would demonstrate SDR, this study used the Balanced Inventory of Desirable Responding (BIDR) (Paulhus, 1993). Several studies have established the reliability and validity of the BIDR (Mellor, Conroy, & Mastellar, 1986; Paulhus, 1984, 1993; Quinn, 1989).

Using a true experimental design, participants were randomly assigned to one of four experimental conditions. Once all surveys were completed, a 2x2 analysis of variance (ANOVA) was conducted with the survey's administration mode (i.e., WWW-administered and paper-administered) and the participants' identifiability level (i.e., anonymous and non-anonymous) as the independent variables and the participants' SDR levels measured by the BIDR as the dependent variable.

Findings

The main effect for survey administration mode was not statistically significant ($F(1,174)=.071$, $p>.05$). Students taking the survey on the WWW ($M=15.33$, $sd=6.23$) did not demonstrate significantly less SDR than did adult students taking the same survey on paper ($M=15.07$, $sd=5.50$). Furthermore, the main effect for participants' identifiability level was not significant ($F(1,174)=.150$, $p>.05$). Students taking the survey anonymously ($M=15.03$, $sd=5.47$) did not demonstrate significantly less SDR than did survey-takers who were asked to identify themselves ($M=15.39$, $sd=6.29$). Finally, there was no significant interaction ($F(1,174)=.027$, $p>.05$), suggesting that no differential effect on SDR was noted with the combination of independent variables.

Conclusions

One explanation for these findings may be that, unlike the current study, most previous studies linking lower anonymity with higher levels of SDR administered their surveys within the context of the experimental setting. However, in the current study, after the professor distributed the manila folders, students were allowed to depart the classroom with the expectation that they would complete the survey on the WWW or paper prior to the next lesson. Undoubtedly, students completed the survey in many different locations -- at home, at work, at school, in a computer lab, and so forth. As a result, even those students in the non-anonymous WWW and paper-administered survey conditions whose instructions included a directive to type or print their names on the survey may have felt a sense of anonymity as they completed the BIDR. This pervasive sense of anonymity experienced by the participants may have mitigated the effects of self-identification created in the study, thereby contributing to the lack of a statistically significant main effect for participants' identifiability level.

Furthermore, research has suggested that a survey-taker's perception of the verifiability of her or his survey responses may impact the extent to which the survey-taker stretches the truth in an effort to make a good impression (Lautenschlager & Flaherty, 1990). Specifically, when respondents believe that their answers cannot be validated, they tend to exhibit higher levels of SDR than when they think that their responses are verifiable. In the current study, however, participants were told that the results of the survey would be used in an upcoming discussion of data collection techniques. As a result, participants may have believed that the responses were being verified, thereby negating any SDR effects prompted by the method of survey administration (i.e., WWW or paper).

In the past, one factor often associated with lower levels of SDR in computer-administered survey responses than in paper-administered survey responses has been the standardization that computer administration affords (Feuer, 1986). In computer-administered surveys, SDR may be reduced by controlling the respondent's ability to preview, skip, review items, and change responses. In other words, the greater structure imposed by the computer mode of survey administration may limit respondents' ability to reveal themselves in the best possible light. However, in the current study, the survey's presentation on the WWW was designed to maximize participants' freedom to negotiate the instrument. Students who accessed the BIDR through the WWW had complete latitude to preview, skip, change, and review their responses to the items prior to submitting their surveys electronically. As a result, the restrictions often inherent in computer survey administration which lead to lower levels of SDR were not evident in this study, perhaps contributing to the non-statistically significant main effect for survey administration mode.

Finally, although early research revealed that computer-administered survey settings seemed to reduce SDR because those settings offered greater anonymity and were perceived as impersonal and nonjudgmental, recent studies have discovered a growing concern among many survey-takers that computers are becoming overly intrusive (Rosenfeld et al., 1996). This concern, sometimes labeled the 'big brother syndrome" (Martin & Nagao, 1989), suggests that people are becoming more aware that computer communications can be monitored and shared. Computer-users who suspect "big brother monitoring" have reported increased anxiety, fatigue, stress, and reduced job satisfaction (Eisman, 1991; Iadipaolo, 1992). In the current study, students in the computer-administered survey condition may have felt that their responses, even in the anonymous condition, could and perhaps would be traced to them through the WWW. As a result, participants may have felt less inclined to present themselves in a truthful manner.

Although increased objectivity and cost effectiveness have often been associated with computer administration of surveys relative to paper administration of surveys, this study's findings should be considered carefully by all professions interested in using the WWW to obtain truthful and accurate information from survey-takers.

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Teaching the Value of Collaboration to the Student Web Developer

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Abstract: Students who pursue a career in web development generally undertake coursework that provides them with practical experiences employing the latest technology. An equally important skill to the web developer, however, is the ability to interact with both a client and target users to assure that web content meets the identified needs. Although there are numerous course models that describe how to teach technical skills, few models include opportunities to enhance these students' interpersonal skills. In order to increase the level of realism on a standard course assignment to include both types of skills, two university professors implemented a collaborative assignment that required students to develop a web page for real clients. This paper will share the experiences from this short exercise that gave students practice applying their newly acquired HTML skills as well as introduced students to the value of collaborating with clients through an electronic medium.

Background

The co-authors teach similar web development classes at different university locations. A major part of both classes is a team project where students develop a web site for a local business client. Since the team project allows the student teams to divide the workload according to the skills and strengths of individual team members, there are a number of students who complete the class without ever having to communicate with a real client regarding a web development task. For the purpose of providing every student the experience of collaborating with another person, an individual collaborative activity was designed.

The assignment partnered students on one campus with students on another campus. To give students in both groups sufficient incentive to be responsive to each other, the same assignment was given to all. This approach was also expected to help minimize confusion regarding different or conflicting assignment requirements.

The assignment itself was posted on the course web sites two weeks prior to the due date; however, one group started a week before the other group. The distance between the two schools made email the preferred mode of communication. This method of exchange was used to pose questions, review responses, and solicit feedback on prototype web pages until an acceptable page was ready for submission. Since the duration of the assignment was relatively short, it was important that the content to be supplied by the student clients would require little preparation. It was also important to develop an assignment that the student developers could design fairly quickly without too much additional research. For all of these reasons, creating a resume page for their client was the ideal choice of assignment.

Unexpected Problems

Although both groups had the same amount of time to complete the assignment, the graduated deadlines presented a bit of a problem. Even in a society that is so enamored with email and the Internet, the ten-day period was simply too short to assure that the student clients would return timely responses to queries posed by the student developers. Scheduling the assignment early in the semester -- a period where some students may drop the class without requiring the instructor's signature -- further exacerbated this situation. Thus a few students were faced with a disappearing client a few days prior to the deadline.

The most difficult problem was due to the compressed timetable of the assignment coupled with different schedules for both groups of students. The assigned pairings were posted with known email addresses two weeks prior to the due date. The instructors expected the student developers to immediately contact their assigned student clients, and notify the instructors when problems arose. In a perfect world where everyone checks email multiple times throughout the day and every day of the week, this approach would work; however, reality often presents unexpected challenges that can create unique learning opportunities as well as frustrations. Although some students did start early, a few failed to appreciate the communication challenge that lay before them. They unfortunately procrastinated too long creating a situation where there was insufficient time to get the required information to successfully create the resume page for their assigned clients. Even the cases where the student developers started early, some of them discovered that the assigned student clients gave the wrong email address, did not check email frequently, or did not respond in a timely fashion (possibly due to different deadlines and priorities).

Both instructors spent considerable time trying to track down these students to get the correct email addresses or encourage the student clients to check their email and send an immediate response. In the majority of cases, they were successful in getting correct email addresses and encouraging timely responses. In the remaining cases, alternate clients had to be assigned. In all cases, both instructors advised the student developers to design the resume page using their own personal data. This page could then be used as a template when the client sends the necessary information. Regardless of the resolutions, the time delay was a cause of stress for the affected student developers who were left with a shorter time period to complete the task.

Another unanticipated problem was the concern some student clients had regarding the sharing of their personal information with strangers (assigned student developers) on a public forum (the Web). A few were also concerned that prospective employers may find the unapproved version of their "resume" that would be posted on the Web. In both universities, the facilities are managed by support staff who require advance notice for changes to the technical environment. Luckily, most of these security and privacy issues were addressed through the cooperation of the technical support staff who did secure the server housing the resumes.

Planning for Future Success

To gauge the success of this exercise, both the student client and student developer were required to complete an evaluation form designed by the instructors. The developers shared the challenges they faced in completing the assignment, while the clients evaluated the resulting web page as a typical client might. Through these collective responses, it is apparent that the initial implementation of this exercise yielded many learning opportunities for students and instructors alike. Much of the instructors' learning from this semester's implementation included a list of "what not to do" the next time such an assignment is implemented in a class setting. Nonetheless, despite the numerous, unexpected problems, the students were able to meet the requirements and achieve the collaboration goals set by both instructors. Part of the success for this implementation was due to the flexibility of both instructors in resolving tenuous situations in a manner that was mutually agreeable to students and instructors. However, in subsequent implementations of this exercise, there are planned changes to minimize problems and further maximize the learning experience for students. For example, to avoid the invalid email addresses, all students will be given a preliminary assignment that requires them to send email to their instructor. This pre-activity will allow the instructors to collect a known, working email address.

In previous semesters, many student teams had communication problems with their clients on the semester project. In the semester where the resume assignment was used, no client communication problems on the team project were reported. The authors believe that the resume exercise raised sufficient awareness in every student to alleviate client communication problems. During the presentation of this paper, the presenters will share the design of the collaborative assignment, the initial implementation, the feedback form, the lessons learned and planned improvements for subsequent implementations of this collaborative activity.

Facilitating Face to Face Instruction with Online Resources

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Abstract: Using online resources in combination with face-to-face instruction can provide a number of opportunities to enrich the teaching and learning experience. The Internet offers an easily accessible and updateable format for posting standard course information, linking to other web-based resources, providing access to downloadable templates and product examples, expanding opportunities for communication beyond the boundaries of the classroom, publishing student work, and collecting data. This paper provides a brief description of seven components that can be used to facilitate instruction within the traditionally structured weekly course.

Introduction

Originally, the purpose for developing a class related website was to deliver basic course information and materials to students. This early vision was to include the syllabus, a calendar of events, and an additional section for a few related links. Over the course of several semesters this original intent has expanded to seven major components, including nearly 300 hyperlinks to resources, course materials, student projects, web-based discussion space and more. Internet resources can provide a broad range of support to the structure and content of the typical weekly course. Keeping course materials online can help students stay up-to-date on announcements and requirements, while also providing access to products and collaborative tools. While this framework was developed for use with technology instruction for K-12 teachers the seven components, outlined below, are adaptable to other areas of instruction.

Components

Course Information: Typical materials like the course syllabus and weekly schedule can be kept online. Publishing these materials online provides greater accessibility and allows for easy revisions and additions throughout the semester. The session agenda and assignments can be updated on an as needed basis to adapt the sequence and pace of content while also being available to keep students and the instructor on track. While these resources are typically provided in hardcopy form, students commented that they preferred having them online. Having all of the class resources in a central location put everything where it could be found when needed. A student wrote, "I did not need to hunt for my bag with the course work - just clicked the mouse and everything I needed to know about the class was there." Another student commented that she "liked the way the schedule could change when it needed without a big deal." Several students also commented that having this information available online provided clarification and eliminated many unnecessary questions. One stated, "I have felt very secure knowing that the general outline of work for the class is at my fingertips! I think it has had a positive effect on class structure in that it eliminates class confusion, lengthy questions, and wrong information spread by mistake."

Resources: The reading list for the class, which may include lists of print material and links to electronic resources, can be maintained and accessed as needed. The online format makes it easy to update as new resources are identified by the instructor or submitted by students. Links to existing web-based resources—online journals, affiliated organization, etc.—can provide a broad range of current and relevant information. While the list of resources can become extensive (one student stated that there were "too many some weeks") it offers an opportunity to take the content of the course beyond what can be covered during class time. Having links to these materials also provides students with the option to select alternative reading material that is relevant to areas they want to explore in more detail. One student commented that she liked the opportunity to print and read material that related to her interests. A number of students remarked that they preferred to make hardcopies of their selected readings rather than reading the material on screen.

Templates and Materials: Instructor developed items—slideshows, spreadsheet files, database files, and word-processed documents—can be linked for students to download. These can be finished products or materials that students will use for coursework. One student commented that having the "templates saved time and provided a uniform starting place for all students." Students suggested that having sample products online also helped them "see the true potential of technology." A student wrote, "The templates and samples offered us help when we were alone, working late at night on projects."

Discussion Group: Web-based discussions can breakdown the barriers and limitations of in-class discussion time. Discussion space can be used for continuing in-class discussions, starting new discussions, submitting assignments that can be viewed by the entire class, posting questions and sharing ideas related to course content. Some students commented that having access to postings from everyone in the class provided an opportunity to see issues from multiple perspectives—giving them "new ways of thinking about the topics." Others saw this medium as a time saver, stating, "You don't have to wait for everyone to orally give their thoughts." Another student commented that the online forum "would probably help students who are inhibited…they could post their comments rather than saying them out loud." On the other hand, a student stated that the comments posted to the group were "not as private" as he would like. Overall, students believed that the forum provided a beneficial means for extending class discussions. As one student stated, "no one person could monopolize the class discussion. It allowed us to 'hear' everyone's point of view." Students also liked that the forum provided a written record, "notes", of contributions that could be accessed at anytime by the instructor and their classmates.

E-mail List: This component is useful for class announcements, assignment reminders, and making clarifications on items of common interest. Students can also share information and ideas with the instructor and each other using this format. E-mail, separate from the list, provides an additional medium for submitting assignments and questions to the instructor. One student commented, "The email was useful in contacting you for help, but it was also helpful in building a sense of camaraderie within the class." Several students liked the opportunity to email questions or ideas to the instructor or to the group as they arose rather than having to wait until the next class session to get an answer or share a thought. The negative aspect of having the listserv, as one participant pointed out, is that "some people got a little too happy with the send key." On the whole, however, even this participant believed that having the list "was more valuable than not."

Electronic Portfolio: The web also provides a format for publishing student papers and projects. This format facilitates sharing with current and future class participants. Students also enjoyed seeing their finished products online. One wrote, "The materials we produced seemed 'real' once they were online."

Data Collection: Online forms can also be created and used to gather information from class participants. The format and purpose may vary from gathering answers to open ended questions to asking students to complete a checklist or survey. Data from students might prove beneficial for evaluating the content of a course, a specific instructional method, or for measuring student progress by having them complete a confidence survey or self-evaluation.

Conclusion

Students suggest that having course materials online provides them with easy and up-to-date access to information when they need it. Having electronic means for distributing basic information and announcements facilitates more efficient use of in-class time. The ability to continue discussions online provides greater opportunity for participation from students who may remain silent in the typical in-class situation. Access to e-mail and web-based discussions provides a forum for sharing ideas and asking questions as they arise. Publishing student materials online provides more opportunity to share knowledge and products with other participants. The flexible and updateable nature of the WWW offers many useful components of support that can enrich the teaching and learning experience.

Accommodation and Learning in 3D Environments

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Abstract: This paper presents early results from three user studies carried out to investigate if encasing a website with learning materials with a 3D environment has any impact on user attitudes toward the learning materials. The results indicate that user attitude toward such learning materials can be enhanced by even a rudimentary 3D environment and more so by more sophisticated 3D environments.

Introduction

From overviews of the HCI-literature (Helander 1997, Schneiderman 1998) it is evident that studies in HCI are largely about users as cognitive rational beings and not about attitudes and subjective components. Works that treat of subjective approaches to HCI such as those by Laurel and Moser (Laurel 1997, Moser 1996) are seldom combined with empirical work. The effort here is to understand the subjective phenomenon of accommodation (Hedman 1999) through user studies. The notion *accommodation* denotes those *workings of human subjectivity* that determine and constitute attitudes of accepting/rejecting an environment such as a digital community or a web site. Accommodation is e.g., important to understand for business organizations crafting digital communities on the Internet. More generally, accommodation should be taken into account by digital environment designers guided by what is normally termed a *user oriented* perspective. The expression *user orientation* is misleading, however, for it does not adequately indicate the focus of analysis. User orientation applied to digital environments reflects a stance of *tool users* rather than *visitors*. *Visitors* of digital environments can accept or reject environments on grounds beyond the horizon of traditional usability. The analytical perspective inherent in *user orientation* is suitable only to a limited extent for digital environments. So far three user studies have been conducted. In these studies users were assigned to learning tasks in D ActiveWorlds-environments.

Study One

In this study a simple web site with materials from a course on conceptual modeling was produced. The site contained texts, conceptual modeling examples, photos and video clips. Twelve subjects participated and six were assigned to a learning task using the web site (in this case only one monitor was used). The remaining six were assigned to the same learning task, but with a basic 3D environment with few features (fig. 1) constructed around the web site.

Figure 1: The 3D environment from study one

After the subjects within each group had performed the learning task they were given a questionnaire. The main part of this questionnaire contained propositions to which the subjects could indicate their level of acceptance or rejectance on a scale ranging from 0 to 1. Propositions such as "To learn from the exhibition is easy" and "The exhibition is engaging" were used to probe for attitudinal responses. Open-ended questions such as "What is your opinion of the esthetics of the exhibition?" and "What did you not like about the exhibition?" were also included in order to give a richer picture of the way users felt about the environments. Such comments were used when the initial 3D environment was redesigned for the second study. Using an identical web site in both conditions allowed exploration of the impact of basic 3D encasing. The users in the 3D condition clearly perceived the learning materials to be more engaging as well as easier to understand when we compared them to the users in the web site only condition. This was despite the fact that they were exposed to the same content in both conditions.

Study two

Eleven subjects participated in the second study. Based on how users perceived the first basic environment an attempt was made to build a compact, pleasant and less sterile environment (fig. 2). The course content was perceived with still greater positive regard than in any of the earlier conditions.

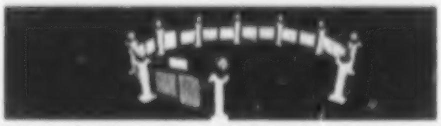

Figure 2: The redesigned 3D environment in study two

Study three

No direct enhancements of the accommodative determinants of the environment from study two were made, but the environment was equipped with navigational links (teleports) for efficient and precise navigation. Five subjects participated in this study. Some users had expressed a desire to move around in the environment by clicking on the places they wanted to go to and our hypothesis was that efficient navigation would yield more positive attitudes towards the learning materials. With teleports, the content within the environment was used more efficiently and the users went through the materials in record time. Although visitors could access the learning materials more efficiently, the materials were perceived with less positive regard than in the previous study. One hypothesis to investigate is whether this had to do with an experienced loss of control. Although the subjects themselves made the choice to teleport to the different content areas and initiated the action, they were still *being teleported*, i.e., *transported*, and as such the *locus of control* appeared to have shifted by degree from internal to external. Another hypothesis is that when user attention shifts from the 3D environment to the learning materials the impact of accommodative influence of the 3D environment weakens.

Conclusions

As this paper presents work-in-progress these conclusions are tentative. Our first finding is that encasing learning materials within even the most rudimentary 3D environment has a positive impact on user attitudes to those materials. A rudimentary environment, however, is not the best environment for promoting positive attitudes to such content. Nor is it necessarily the most efficient environment. Creating a 3D environment for promoting positive attitudes to learning materials should involve research pertaining to how users come to develop attitudes of rejecting/accepting the environment, i.e., how they accommodate. So far the following determining factors for promoting positive attitudes are emerging. First the environment should be designed so as to not be perceived as sterile. The environment should also be perspicuous and designed in a compact way. Finally teleports should be used with caution or avoided in small environments.

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Software Quality on the Net: From Desktops to Internet Appliances

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A study by IDC indicates that Internet appliances will account for 42 percent of total information access appliances by 2001. These appliances range from WebTVs and desktop-like machines, to kiosks, to handheld devices and cell phones, to refrigerators and microwave ovens. The proliferation of Internet appliances brings with it a proliferation of Web access options that delight information-hungry consumers, but are a nightmare to Web developers. Some users may surf the Web on an HTML-enabled browser. Some may only want to access time-sensitive, critical information using their WAP-compliant wireless phones. Others may enlist the assistance of a proxy server to view traditional Web sites in a format tailored for their particular handheld device. Deciding which of these technologies to support is a topic fit for its own paper or presentation. In a nutshell, all companies should ensure that their site is available to anyone who has a means to surf HTML pages, and only those whose site contains small tidbits of time-sensitive, critical information should think about supporting technologies such as WAP-compliant browsers, Web clippings, channels, and the like. Once you've decided which technologies to support, you should start thinking about how to ensure that your site operates flawlessly on those technologies. Here are some little-known quality control tasks that can dramatically improve site quality for Internet appliance users-- no matter which technologies you choose to support.

Tip 1: Ensure that your code strictly complies with language specifications

The best way to ensure that your site works on Internet appliances is to ensure that its code is flawless. By "flawless," we do not mean "appears to work flawlessly on the desktop browser," but rather "strictly complies to the language's official specifications."

One of the few things that most embedded browsers share is the need for a small footprint. With a small footprint comes a tendency to support only standard language elements and usages. This means that some serious problems will arise if we take the somewhat careless coding habits that large footprint desktop browsers have allowed us to support, and apply them to pages that are accessible from Internet appliances. While most desktop browsers tend to correctly render non-standard code, many embedded browsers will not.

Before you produce any more HTML, WML, or HDML code, you should familiarize yourself with the language's official specification, then resolve to use only the elements detailed in the specification, and to use these elements only in the ways that they are intended to be used. The only way to ensure that non-standard elements or usages will work is to test them on every possible appliance or emulator. Even then, there is no guarantee that non-standard tags and usages will continue to be supported in future browsers.

Next, take a second look at your existing code and make any necessary changes to ensure that it complies with all relevant standards. Pay particular attention to your HTML code: this is probably where most of your problems will occur. If your existing HTML code does not strictly comply with HTML standards, pages which operate wonderfully on desktop browsers may not only contain problems when accessed on Internet appliances, but they may not function at all.

For example, desktops browsers are forgiving of non-standard link statements. The HTML standard requires that links take the following format:

```
scheme://host/path/extra-path-info?query-info
```

Most desktop browsers have no problem with non-standard link constructs such as URLs with "new-line" characters and URLs that contain "\" instead of "/", but there is no guarantee that these links will function at all on the stricter embedded browsers.

Another example: While almost all desktop browsers forgive violations of the first-in, last-out stack strategy specified in the HTML standard, embedded browsers may not. This means that just one "crossed" tag can result in a variety of problems that range from incorrect formatting to entire page elements (such as navigation bars and forms)-- or even entire pages-- that fail to display at all.

One of the best ways to avoid such problems in any language is to create and enforce coding standards: rules that flag occurrences of non-standard or dangerous (i.e., error-prone) language constructs. There are several ways to enforce coding standards:

- Manually, during a code review.
- Automatically, with a third-party tool.
- Automatically, with proprietary programs or scripts.

Manual enforcement is usually not practical considering the typical length of Web development cycles. And because so few tools available are specifically concerned with enforcing standards applicable to Internet appliances, your best bet is to either find a customizable coding standards enforcement tool, or to create your own automatic enforcement process.

Tip 2: Reduce download time

Minimal download time is critical on Internet appliances. Some appliances cannot download large files due to device, memory, processor, and bandwidth limitations. In addition, many users could be accessing information in time-critical situations (such as in the car, at a stop light), and some are paying up to 50 cents per minute for Internet access.

The obvious way to reduce download time is to reduce image size and page content. Many Internet appliances, particularly phones, will not download pages whose size exceeds a certain limit. If you are particularly concerned about your site working on a specific device, find out what its size limit is, then create and enforce a coding standard that says to avoid pages whose size exceeds that limit. This will allow those devices to download the page, as well as help ensure that all users can download your files in a reasonable amount of time.

A few non-obvious ways to reduce download time include:

- *Avoid dynamic generation of static data:* Many sites unnecessarily increase their pages' download time by performing "dynamic" generation of static data (such as daily specials and lists of account representatives). Any time that server-side technology is used to dynamically generate the same exact page, over and over again, you should create a static version of the page and, if feasible, build an infrastructure that updates the page as frequently as is necessary.
- *Strip unnecessary white space:* White space is often used to increase a code readability and presentability. However, white space increases file size, and file size directly affects both file download time and server load. Removing excess white space typically results in a 10-50% percent reduction in file size, which results in a 10-50% reduction of download time and server load.
- *Use relative links whenever possible:* Using relative links (e.g., /press/index.htm) instead of absolute links (e.g., http://www.parasoft.com/press/index.htm) reduces download time and server load because a DNS router does not need to look up the host for each new page. Also, because relative links have fewer characters than absolute links, using them also increases download speed because it reduces file size.
- *Remove any unnecessary tags:* Browsers read and render every tag that they encounter-- even tags that do not contribute to page presentation or functionality (such as empty tags, or unnecessary   tags). By eliminating the excess tags that are often added by code-generation tools or sloppy coding practices, you can significantly reduce rendering time.

Tip 3: Don't limit critical content to elements that are not universally supported

All Web developers should learn which elements, languages, and file formats are not consistently and universally supported by HTML browsers used by Web surfing Internet appliance users, then make sure that any critical content that appears in such elements is also available in an alternative format. For example, if you use an image map as a navigational aid, add text links that allow users to reach the same destinations. If you have a product brochure available in pdf format, add an HTML version as well, or offer users the option of having that file emailed to them. While support varies from product to product, some elements you should generally avoid limiting critical content to include frames, applets, JavaScript, tables deeply nested in other tables, image maps, and pdf files. Also, beware of poorly supported tags: tags that are standard, but that are not rendered consistently by most browsers. If you find that a tag is poorly supported, it is best to remove it and replace it with a better supported tag. If you are supporting technologies such as WAP appliances, Web clippings, and the like, you will have an even more limited set of "safe" elements and formats. If you have a site that is designed exclusively for one of those types of technologies, it is best to remove any element that is not consistently and universally supported, then replace it with an element that definitely works in the given technology.

The best thing to do is research the technologies that you are interested in supporting, and learn which tags are not universally supported. One way to start is by looking at accessibility guidelines: there is usually a high degree of overlap in the guidelines for accessibility and those for embedded browsers. Once you have learned what is supported and what is not, you should create coding standards that alert you to the use of any of these elements; this makes it easy to check that any important item contained in a questionably-supported element is also available in a supported element. Like the coding standards discussed in Tip 1, these standards can be enforced manually, with a customizable third-party coding standards enforcement tool, or with proprietary programs or scripts.

Conclusion

Ensuring the quality of sites which can be accessed anywhere from a phone to a TV to a refrigerator is a difficult task indeed. Using these tips will not only improve the chances of your site operating flawlessly for your intended Internet appliance audience, but it will also ensure that your site continues to operate as expected for traditional Web surfers as desktop browsers move closer and closer to standardization, and it will enforce good coding and design practices that will improve all users' experience on your site-- no matter what type of system or appliance they're accessing it from.

The Promotion of Scientific Process Skills Through Network-Based Courseware

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Abstract

This article presents the development and evaluation of a network-based courseware which was used to cultivate high school students' scientific process skills. The courseware developed in this research was targeted to prompt students to analyze tide data and test the models which were used to represent the cause of tides. Forty, 23 females and 17 males, first-grade students in Luodong Senior High School were selected as the sample in this study. Students were grouped into 8 heterogonous groups to take advantage of cooperative learning environment. Based on detailed analyses of students' computer dialogs, interview protocols, and scores of tests, we documented the construction of students' understanding in concepts related to earth sciences and their changes in science process skills.

Introduction

The rapid development of modern information and communications technologies has opened new possibilities for establishing and delivering distance learning. In addition, the new learning paradigm based on cognitive learning theories can emphasize the quality of the learning process. We are living in an era in which information virtually grows fast every day, work requires higher and higher information skills (O'Leary, 1998). Learning and teaching cannot come from books alone. The essential contents of learning include the ability to process information systematically, to read complicated diagrams, to solve problems effectively, and to communicate with others conveniently. To create a learning environment for these needs, a cooperative learning method is embedded in a network-based courseware.

Additionally, students build new knowledge based on pre-knowledge according to constructivism. It is very efficient to construct knowledge when students are in a cooperative learning environment (Savery & Duffy, 1995). As Vygotskian (1978) proposed, individuals need to interact and communicate with others in order to gain better understandings. Cooperative learning increases dialogue among students and potentially promote students' comprehension of knowledge. Networks provide a powerful means to surmount the barriers that make shy or slow students fail to communicate with others. Through this approach, low cognitive students will learn from high cognitive students in such social situation (Hooper, 1992). Therefore, cooperative learning promotes students' abilities on conceptual development, information skills, and critical thinking. In order to make cooperative learning more efficient, it has been suggested by researchers to group students based on heterogeneity and the number of members in a group is from 4 to 6(Johnson & Johnson, 1994).

Students of all ages have been shown to have difficulties in understanding and applying the concept to scientific inquiries (Lin and Lehman, 1999). We hypothesized that inciting students to be familiar with scientific process skills would facilitate them to apply the concept to scientific inquiries and to learn in a way that would help them transfer what they have learned. The network technique is used to provide a cooperative learning environment which helps low cognitive students overcome the barriers in their comprehension of the task, general understanding of science and scientific process ski'ls, and communication skills. The purpose of the study is to investigate whether students' concepts and scientific process skills are improved after interacting with a network-based courseware which provides prompts on data analysis and hypothesis testing.

Methodology

In this study, the authors used methodological triangulation which used multiple methods for collecting data. The purpose of this integrated research methodology which include both quantitative and qualitative methods, is to compensate for the shortcomings of one methodology with the strengths of the other (Kafai, 1995; Kidder &Fine, 1987; Light & Pillemer, 1984; Maxwell, Bashook & Sandlow, 1986; Mischler, 1990). The data collection integrated multiple instruments of observation and assessment: paper-and-pencil tests, computer protocols, classroom observation, and semi-interviews.

Sample

Forty first-grade students in Luodong Senior High School were selected as the sample in this study. There were 23 females and 17 males in the sample. Students were grouped into 8 heterogonous groups for the purpose of cooperative learning. Gender was considered so there was almost equal males and females each group. The scores in high school entrance examination in mathematics and science and pretest of tide concepts were used as standards to group students. After grouping, the scores in the entrance examination and pretest in each group were tested with ANOVA ($F=0.318$, $p<0.05$). It showed that there was no significant difference among these 8 groups in their pre-knowledge.

Research Procedure

The research procedures were divided into three parts: pretests, treatments and posttests. Basically, it is an experimental design. Quantitative and qualitative data had been collected through the parts in the procedures, respectively. In the pretests and posttests, students' concepts, science process skills and attitude to computers were investigated. Additionally, interviews were conducted to investigate students' perspectives about cooperative learning and the web-based courseware after posttests. The treatment was students interacted with a web-based courseware, named "Tide", through cooperative learning.

Data Analysis

In order to test the differences of students' concepts and science process skills before and after the treatment, the researchers used Wilcoxon signed ranks test to analyze the data because the scores of pretests and posttests were not normal distributions. For further analysis, students were grouped into three groups: low-SPS (the lowest 33% students on the scores of SPS pretest), high-SPS (the highest 33% students on the scores of SPS pretest), and medium-SPS (the others). The repeated ANOVA was used to analyze students' progresses of SPS in the different groups before and after the experiment.

Learning Activities

A network-based lesson, named "Tides", has been developed to support cooperative learning. This lesson allows students to explore concepts related to tides, such as two high tides a day, two high tides roughly every 12.5 hours, and the cause of the tides, through raw data and animations. After complement of several exercises, students work on a project cooperatively using observational data of rainfall and tide to explain why a Typhoon caused disaster during the period of high tide and decide when is the best time to do flood discharge in this typhoon case. Learning activities were delivered through web and students' learning processes were tracked using network technology. The records of students' learning paths and communication protocols were used to understand how students sought and shared information in their problem solving process. A follow-up interview was conducted to get a better understanding on the interaction of students in a group.

Conclusions

As shown in Table 1 and Table 2, the network-based courseware used in this study can help students gain a better understanding on the cycle of tides and the cause of tides ($z=-3.243$, $p<0.05$), and learn more about the process of scientific inquiry ($z=-4.920$, $p<0.05$). This study has designed a cooperative learning environment using network techniques to enrich students' scientific process skills and communication skills. In such environment, high cognitive students could conveniently help low cognitive students work on learning tasks. From the analysis of repeated ANOVA, it showed that low SPS , medium SPS and high SPS students' scores of SPS posttest were significantly higher than the scores of SPS pretest ($F=133.571$, $p< .05$). From Post Hoc, we also found students with different SPS abilities had significant difference on their SPS progresses ($F=25.849$, $p< .05$) (see Table 3 and 4). As the Post Plot shown (see Figure 1), low-SPS students made much bigger progresses than medium-SPS and high-SPS students. Low-SPS students made the most progress on their science process skills and high-SPS students made the least progress on their science process skills after using "Tide" courseware.

Hooper (1992) found that high cognitive students' concepts were promoted when they helped low cognitive students to organize information. In his study, it was also found that all students benefited from cooperative learning process. Through cooperative interaction, high cognitive students elaborate their concepts when they explain their ideas to low cognitive students. Low cognitive students reconstruct their knowledge when the get new information from high cognitive student. From our study, we found all students' science proves skills were promoted after interacting with the web-based courseware and low-SPS students had the most progress and high-SPS students had the least progress. High-SPS students did not make much progress due to the ceiling effect. There was not much room for them to make big progress. On the other hand, low-SPS students can benefit much from cooperative learning because they can learn from others. The value of heterogonous grouping in cooperative learning is to let students help each other reconstruct their knowledge and promote their abilities. Many research also found that heterogonous grouping benefits low cognitive students more than high cognitive students. (Johnson & Waxman, 1985; Van Oudenhoven et al., 1987; Hooper & Hannafine, 1991). Therefore, heterogonous grouping can increase weak learners' participation and their motivation in a cooperative learning environment. Such learning environment facilitates weak learners to become active and happy learners.

The data from interviewing 3 groups (15 students) showed that most students thought the web-based courseware was much interesting than the textbook due to the animations and interactions, and the on-line discussions made them feel more involved in learning activities. Few students (2 students) can not feel comfortable when they participated in the on-line discussions because of their low speed on typing Chinese.

Overall, the web-based courseware provides a cooperative learning environment which can promote students' conceptual development and their science process skills. As Lockyer, Patterson, and Harper (1999) found in their study, students' learning were more efficient through networking cooperation than face-to-face cooperative learning because students can read more information to elaborate their concepts before they communicated with others. Besides, through networking computers can record students' dialogs for the teacher to understand students' learning. If it is necessary, the teacher can provide further assistance to help students overcome the obstacles. The sample in the study was small because of limited number of computers. Bigger sample is considered for future research for better understanding of how different background students benefit from this web-based courseware.

Table 1: Wilcoxon signed ranks test of scores on pretest and posttest of "tide" concepts

	Mean	S.D.	Z	p
Pretest	9.30	1.90	-3.243*	.001
Posttest	10.38	1.81		

*: $p<0.05$

Table 2: Wilcoxon signed ranks test of scores on pretest and posttest of science process skills

	Mean	S.D.	Z	p
Pretest	27.46	4.9	-4.920*	.000
Posttest	31.95	2.75		

*: $p<0.05$

Table 3: Descriptive statistics on pretest and posttest of science process skills

	No.	Pretest		Posttest	
		Mean	S.D.	Mean	S.D.
Low SPS	13	21.77	1.74	29.23	2.20
Medium SPS	14	27.69	1.44	32.85	1.68
High SPS	13	32.92	1.89	33.69	2.18

Table 4: Repeated ANOVA on performances of science process skills

	df	MS	F	p
Main effects	1	388.154	133.571*	.000
Interaction	2	75.115	25.849*	.000

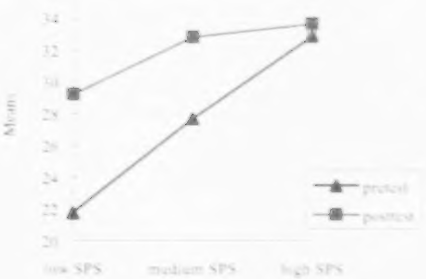

Figure 1: Plot of interaction for sample data

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HomeNetToo; Motivational, affective and cognitive factors and Internet use: A model to explain the racial digital divide and the Internet paradox

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Abstract: The HomeNetToo project is designed to address two fundamental questions. What causes people to use the Internet? What effect does Internet use have on people? A model of Internet use is proposed that addresses these questions by considering motivational, affective, and cognitive factors as antecedents and consequences of Internet use. In the HomeNetToo pilot project, a sample of low-income African American families are participating in interventions to facilitate home Internet use, and completing surveys that address factors proposed by the model. Results of the main study will have implications for how to reduce the digital divide, how to design user interfaces to accommodate diverse cognitive styles, and for identifying factors that influence whether Internet use will have desirable personal, social and professional consequences.

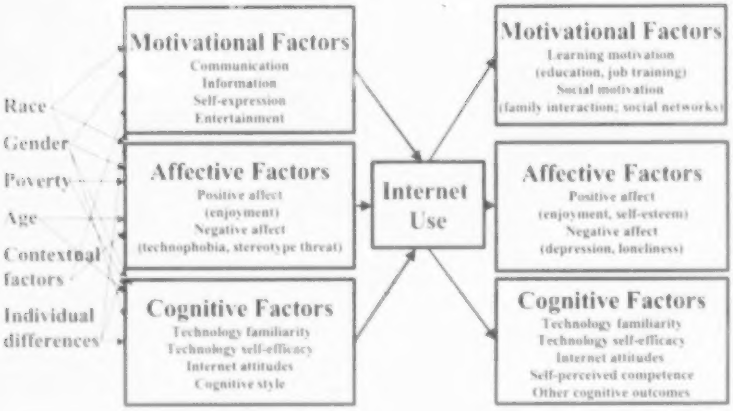
Few question that a racial digital divide exists in the U.S. today (1-9). Most see the solution as increasing access to the Internet, a solution based on the assumption that the cause of problem is fundamentally economic. Research suggests otherwise (13-16). For example, in Hoffman and Novak's much publicized digital divide study (4), at every income level but the highest, Whites were up to twice as likely as Blacks to own home computers. A quite separate line of research suggests that Internet use has adverse effects on personal and social well-being. In another higher-publicized study, researchers at Carnegie Mellon found that greater Internet use was associated with greater depression and loneliness, and with reduced social contact (14-17). These findings are paradoxical because the Internet has been touted as primarily a social technology (cf.22-29).

Jackson and colleagues (30) have proposed a model of Internet use in which motivational, affective, and cognitive factors are both antecedents and consequences of use. Briefly, people use the Internet because it satisfies motives (e.g., communication, information), is associated with positive affect (e.g., flow), and because the cognitive requirements for use match the user's cognitive repertoire (e.g., skills, attitudes, cognitive style). Internet use, in turn, has motivational, affective and cognitive consequences. For example, it may increase or decrease social motivation, positive affect, and favorable attitudes toward Internet technology.

HomeNetToo is an ongoing pilot study of home Internet use by low-income African Americans in Lansing, MI (62). Interventions that emphasize communication or information motives are being administered during home visits from the project website (www.msu.edu/user/jackso67/HomeNetToo/). Surveys at Pre-trial, 1-month, 3-months, 6-months and Post-trial are assessing motivational, affective and cognitive factors suggested by the model of Internet use, depicted next. For example, measures of depression and loneliness will permit reexamining the relationship between these outcomes and Internet use. The planned project to follow the pilot study will provide a more rigorous test of the model by obtaining multiple measures of key constructs using on-line surveys and computer-logged measures of Internet use. It will also explore relationships between cognitive style and Internet use, and the implication of such a relationship for interface design.

Results of the HomeNetToo research are expected to contribute to basic knowledge about Internet use, its antecedents within individuals and cultural contexts, and its consequences for individuals and society. Practical implications for reducing the digital divide and facilitating Internet use by all members of society will also follow.

Support for the importance of Internet-as-communication tool will be used to establish a preliminary set a guidelines on how best to introduce and sustain use of the Internet. Support for the importance of user cognitive style in


Race
Gender
Poverty
Age
Contextual factors
Individual differences
Motivational Factors
Communication
Information
Self-expression
Entertainment
Affective Factors
Positive affect
(enjoyment)
Negative affect
(technophobia, stereotype threat)
Cognitive Factors
Technology familiarity
Technology self-efficacy
Internet attitudes
Cognitive style
Internet Use
Motivational Factors
Learning motivation
(education, job training)
Social motivation
(family interaction; social networks)
Affective Factors
Positive affect
(enjoyment, self-esteem)
Negative affect
(depression, loneliness)
Cognitive Factors
Technology familiarity
Technology self-efficacy
Internet attitudes
Self-perceived competence
Other cognitive outcomes

interface design will be used to establish a preliminary set of guidelines for the design community about how best to support individual and cultural differences in interface and application design.

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The Evolution of an Entrepreneurial Endeavor at an Educational Institution

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Abstract: This paper discusses the development and progress of an endeavor at Marist College which offers students an extension of their education, while providing funding for upgrading technology. This provides the students with an opportunity to utilize their education to build and improve their communication and technical skills, while giving them *real world* work experience. The Center for Applied Technology (CAT) is a resourceful approach to learning. Working with CAT is a wonderful learning experience not only for the talented student workers, but also for the client and the faculty. The business community benefits by being able to tap into one of the largest resources of talent and skill in the Hudson Valley.

History

Academic Technology (AT) at Marist College is designed to provide technology awareness and collaborative hands-on training in some of the latest IT products to the faculty at Marist. We hire student employees as consultants, graphic designers, content developers, and programmers to develop faculty projects.

Since AT's mission is to support the innovative use of technology within the classroom, we decided to create the Center for Applied Technology (CAT). CAT remains closely associated with AT and bridges the gap between people and technology by creating teams for each project in order to meet the client's objective. As a result, AT/CAT recycles the money gained from these external projects back into the technology supporting the faculty endeavors, while providing businesses with up-to-date technology and lower project costs.

We believe in the preparation of today's workforce for emerging technologies, as well as training our future graduates to be competent in using technology as a tool to increase the undertaking of Business Specific Projects ranging from New Media to general Software Applications. CAT receives projects and outsourced work from several firms in the business community. Each project involves various levels of complexity and challenges to conquer. CAT students begin to fine-tune their skills by first developing a number of faculty web pages. The experience, maturity, and responsibility that are obtained from such internal projects "qualifies" the students to work on these external projects.

As Marist College's commitment to entrepreneurial projects grew, the Enterprise Solutions Group (ESG) was created to support CAT. Unlike CAT, ESG is comprised of full-time Marist College employees that are dedicated to manage and develop external projects. These staff members possess the technical expertise to mentor the students as needed and also provide external clients with a new level of support and reliability.

Case Study 1

Marist College has emerged in New York State as a leader in distance learning. The School of Management has offered a recognized Masters of Business Administration degree program since 1976 and is now proud to offer the first on-line MBA option approved in New York State.

The students of AT/CAT have been heavily involved in the development of each distance learning course using WebCT. They consult with the faculty on the structure of the course and content, guiding them through their first on-line teaching experience. AT/CAT also develops video, audio, and multimedia files as required by the faculty members in order to enhance the quality of their courses.

The valuable experience that the students have gained permitted CAT, and now ESG, to extend into the business community with a solution for their training needs. IBM sought out our skills as an educational institution to provide assistance in designing and developing course materials. Utilizing our expertise in the creation of distance learning applications, Marist College was asked by three separate departments to develop training materials, this time utilizing Lotus LearningSpace.

Case Study 2

ESG and CAT have built up an intense infrastructure of talented people and cutting edge technology that has allowed us to extend beyond the college walls in yet another capacity. The introduction of E-commerce on our campus has energized both staff and students to consider the possibilities that this new frontier has to offer.

While Marist College is structuring an on-line store that will be available to the public in the future, ESG and CAT have stepped into the corporate field offering business-to-business and business-to-consumer solutions. Our largest project is with a company that was founded by a group of experienced engineers, executives, and industrial product distribution experts to assist wholesalers to capitalize on the E-Commerce revolution in a unique way. This company relies solely on the expertise of Marist College's ESG and CAT employees for the development and maintenance of their E-commerce site.

Challenges and Fixes

It is more than evident for any company or institution seeking talented technology proficient individuals that the market is intensely competitive. Every day we face the problems of a rapid student turnover rate, expensive technology requirements, and demanding schedules.

CAT has approached the student turnover rate by constantly seeking responsible and dedicated students with an interest in today's hottest field. We team them up in order to ensure thorough coverage of each project and to mentor/train incoming students to take over specific projects each year before graduation. It is imperative to have foresight while planning each project. Projects never end as there will always be updates and maintenance - it is our job to deliver.

Conclusion

This entrepreneurial adventure is a challenge, but we have built a strong foundation to stand on - the future of CAT and ESG is solid. We will continue working on leading edge projects that will bring in money to support our needs. Time and money are valuable in this environment so it is wonderful that our efforts have had positive results that benefit the college.

A Web-based Factory Teaching System: Design and Development

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Abstract: This paper describes the background and first year effort associated with the development of a web-based, collaborative learning network, funded by the National Science Foundation, which assists in the manufacturing educational needs of engineering students.

Introduction

To be successful in today's business environment, a new engineering college graduate must be educated in all aspects of a manufacturing system. That is, the student must understand the total business process from design to production to delivery in order to develop a holistic view of the manufacturing process (Sackett & McCluney, 1992). Many manufacturing engineering program curricula are overloaded with theoretical science content, with little emphasis given to deeper learning of the total manufacturing environment. For example, engineering courses on factory topics such as inventory control, production planning, and operations scheduling focus on teaching mathematical models based on simplifying assumptions, ignoring many of the factors that exist in real factories such as machine breakage, cancellation of orders, and a surge in demand (Hopp & Spearman, 1992).

Traditional pedagogical tools for transferring hands-on learning to students are ill-equipped to handle the complexity that surrounds the modern factory. Manufacturing education tools have traditionally required physical laboratories (e.g., machine shops). However, factory experimentation through full-scale on-campus laboratories is an infeasible alternative due to the high expense associated with development and maintenance, and the inability to cover the entire manufacturing spectrum. Additionally they can serve only a single site, inhibiting the creation of teams whose members are not co-located, i.e., "virtual" teams which are increasingly becoming a requirement for engineers.

To address the manufacturing educational needs of new engineers, a web-based, multi-media collaborative learning network referred to as a Virtual Factory Teaching System (VFTS), was developed under an National Science Foundation (NSF) grant (Dessouky, et. al, 1997; Kazlauskas et. al., 1997) This tool is designed to help engineering and business students grasp complex factory dynamics that are difficult to teach in chalkboard lectures and impossible to experiment with in real factories. The system allows students, working alone or in teams, to build factories, forecast demand for products, plan production, establish release rules for new work into the factory, and set scheduling rules for workstations. They can run simulations where an animated panel displays jobs progressing through their factory, with queue counts, finished goods counts, graphs, and reporting functions all available.

Now a new three-year project, also funded by NSF, is aimed at significantly expanding the VFTS by performing controlled testing and evaluation. This project will team up students from several universities in addition to USC, at this point in time San Jose State University, and the University of Virginia. Next, we intend to promote the use of the VFTS to other engineering and business schools through conference workshops, promotional materials, and publications, and to also introduce the VFTS to Los Angeles area high school students as a way of promoting engineering careers.

The research plan is aimed at exploring the interface between virtual factories, engineering education, intelligent agents, and the Internet for new ways of teaching modern manufacturing problems, practices, theory, and techniques to engineering and business undergraduate students. It is aimed at examining its potential for use as an information vehicle on the topic of manufacturing for K-12 students. We will address important research questions, such as : how intelligent agents might assume tutoring and participative roles in team settings; how team performance, hampered by geographical separation, might be enhanced via advanced communication technologies and how students might form new mental models and develop new metacognitive skills when using new technology-enhanced modes of learning.

Current Status

The results of the first year of the project included the development of the methods and procedures established for evaluating the VFTS from the student learning and outcomes perspective, including a description of the instruments used to gather student data. Also, there was the development of the initial potential use of the VFTS in a course. For example after a visit to a local manufacturer at the beginning of the semester, upon returning to the university computer lab or to their homes, students will access via the VFTS a virtual representation of the factory they visited. The professor will post assignments related to this factory over the Internet, "unfreezing" parameters as necessary so students may experiment without redefining the entire factory. Students will observe the effects of their decisions. Student teams will assume factory roles to solve problems; if they reach an impasse, intelligent agents will provide guidance. Selective information may be given based on student roles; for example, the production supervisor may have equipment information, the engineer new technology information, etc. Students will sort out strategies and discuss options via e-mail and electronic chat rooms. Since this course is a common one found in many universities, collaboration among faculty is entirely feasible. Faculty members will virtually "team teach" the course. Separate virtual factories could be linked across universities to study their co-dependency.

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A New Image Search and Retrieval System using Text and Visual Features

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Abstract: Many search engines, designed for using text keyword, have been used widely. However, the multimedia contents on the Internet, which includes image, video, speech, and audio, have been increasing fast, and will dominate text only contents. The text-based search engines are not so effective in the multimedia contents search, because text has very limited capability to represent the complex multimedia contents. We propose a new image content search and retrieval system using text and image features, such as color, shape, and texture concurrently. Also we suggest an effective indexing technique that can handle a large amount of image content effectively.

1. Introduction

Since there is so much information on the Internet, we need effective tools to find the exact information we want. For that, many search engines, which are based on text search, have been used effectively. The engines receive text input, and browse the related web site categories or the addresses of documents. If the content that users want is closely related to the input keyword, the engine could search the content effectively. However if the content is not related to the keywords, the search result may not so useful. In many cases, image can not be represented by keywords only. For example, if user want to find red-rose images, user can find rose images with the keyword search. However, red-rose can not be easily obtained, because generally red is not used as a keyword to represent an object even the color of the object is red. But we can get red color feature from image itself by simple color histogram technique. In other words, we can extract the useful feature with content itself. To solve this kind of problem, content -based search and retrieval methods have been suggested. Then, the suggested methods have limited capability in the sense of retrieval time when the amount of the image content to be handled is very large. This problem is closely related to the indexing technique with huge amount of image content features. In this paper we propose a new search and retrieval system, which can be able to handle large amount of image content. For that, the system combines keywords and visual feature for image representation, and uses a new indexing technique that can reduce the searching time and memory of the database.

2. System Components

2.1 Robot for data collection

As other text web search engine, a robot does collect the documents on the web [1]. Then, this system is focused on the image contents so the robot is searching the documents by following the link of the images related.

2.2 Keywords extraction

HTML standard recommends attaching alt tag beside image tag . The alt tag includes the information about the image such as title, size or the related information. But web designer does not follow the recommend well. So besides the alt tag, the keywords for the images need to be extracted from the document title, headline, URL, or the text around the image. In this case, the extracted keyword does not always represent the images, but in many cases the keywords are valuable for that. We used this method for the keyword extraction.

2.3 Visual features extraction

An image can be represented by its features such as color histogram, color layout, texture etc. Each feature can be obtained by time or frequency domain signal processing techniques. Our system uses a feature vector for an image, which is a set of variety of image features. It is well known that a vector of simple features is much more effective than a complex feature to represent an image. We select three image features. Color histogram is obtained using traditional method [2], and color layout and texture are obtained using wavelet transform [3,4]. Since the methods do not require so much computational power, we can handle a large number of images. The obtained features are saved as a vector form and used for indexing and search procedures.

2.4 Indexing scheme

One of the most important techniques of search engine is how a large amount of the obtained keywords and image feature vectors can be indexed effectively to reduce search times and memory. To be a useful search engine, more than one million images should be included in the database. For that, we suggest a noble indexing scheme. The scheme has tree structure using leader clustering method [5]. The tree consists of four layers from root to leaf. In this case, two hundred million images can be indexed theoretically. However, generally a cluster has fifty percent fill rate so fifty million images can be indexed. The indexing is implemented with two steps. First, a tree is constructed, which includes whole images. This tree is used when the query is only visual features. The next step is to construct a tree for each keyword. These trees are used for the query that combines keywords and visual features. To reduce the tree size, only the ID of each image is used.

2.5 Search methods

Three types of queries are possible, which are keywords, visual feature, and the combining of both. The keywords query accesses the center of the first cluster in the related trees. This can show a set of images that are visually not similar. The visual feature query, at the first time, compares the query features and the saved features in the main tree, and shows a set of images that have similar visual features to the query. The combined query is implemented as visual feature query except using the trees that are obtained by the keyword access.

3. Conclusion

We suggest a new image searching and retrieval system. The system combines multi-dimensional image feature vectors and keywords so that user can search a set of images very effectively. Also, as the system use a new indexing technique, user can search the wanted image less than one second in the database that includes more than one million indexed images. With this system, user can give the query with image itself (by using visual features), which will be a promise technique for the next-generation image searching system.

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Modeling Computer Users' Interest in the World Wide Web across the Adult Life Span: The Role of Age, Education, Ability, and Discontentment

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Abstract: The current study examined the factors related to the interest in Web related activities across the adult life span. Using the mediation model put forth by Ellis and Allaire (1999), the extent to which age, education, Web ability, and Web discontentment are related to computer users' interest in the Web was examined.
It was hypothesized that Web ability and discontentment would fully mediate the effects of age and education on Web interest. Six hundred surveys, sampled from the Project 2000 data (Novak & Hoffman, 1997), were used to examine this model. Using structural equation modeling techniques, the mediation model was largely supported. The Web discontentment was found to fully mediate the effect of Web ability, age and education on Web interest.

The adoption of Web has recently expanded from domain of younger adults to something of interest to computer users at all stages of the life span. Previous literatures have mentioned age, education, computer anxiety, and computer skill to be some of the important factors contributing to the interest of using computers and the Web (Ellis & Allaire 1999).

Ellis and Allaire (1999) developed a mediation model of older computer users depicted in Fig.1. The present research varies the applicability of the model in two ways: First, the model was fit to data from computer users across the adult life span. Second, the focus of the present study is on the use of the Web in particular.

The current study examined the extent to which age, education, and Web ability and discontentment are related to Web interest. It was hypothesized that Web ability and discontentment would fully mediate the effects of age and education on Web interest. To test the hypothesis, two questions were addressed: (1) What is the correlational relationship between age, education, Web ability, Web discontentment, and Web interest? (2) Does a theoretically derived model explain individual differences in Web interest?

Procedures and Measures

Six hundred randomly selected subjects from 3776 complete cases with oversampling of the older adults (all of subjects aged 70 years and above were included) of Project 2000 Web-based questionnaire, posted in conjunction with the 7th WWW User Survey fielded by the Graphic, Visualization, and Usability Center (GVU) at the Georgia Institute of Technology (Kehoe & Pitkow 1997) April 10 to May 10, 1997 were analyzed. The respondents ranged in age from 18 to 80 years, with an average age of 44.33 years (S.D. = 15.68 years). The sample was predominantly male (66%). Education levels ranged from high school to doctoral degree averaging 15.39 years (S.D. = 2.29 years) when converted using their medians.

Web-related constructs in Tab. 1 were the underlying concept of measures where subjects were asked to rate in nine discrete points their feelings when using the Web (Web Discontentment), their general feelings about the Web (Web Interest) and self-assessed Web ability (Web Ability).

Construct	*# items*	*Reliability (α)*	*Factor loadings*
Web Discontentment	6	0.85	0.59*** - 0.78***
Web Interest	9	0.92	0.61*** - 0.86***
Web ability	7	0.89	0.64*** - 0.86***

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Table 1: Summary of constructs, *** = $p<0.001$

Results and Discussion

Factor loadings in (Tab. 1) showed that the variables are representative of their respective underlying constructs. Tab. 2 contains the correlations between the five constructs. The three Web-related constructs represent 60.8% of the total variance accounted for by the variables. Corresponding with the finding of Ellis and Allaire (1999), the correlations among constructs were significant at $p<.05$ with the exception of the correlation between education and Web interest. The direction of the correlation is also congruent with the literature.

	Interest	*Ability*	*Discontentment*	*Age*	*Education*
Interest	1				
Ability	0.13**	1			
Discontentment	-0.58***	-0.21***	1		
Age	-0.13**	-0.42***	0.13**	1	
Education	-0.07	0.15**	0.14**	0.18***	1

Table 2: Correlation between constructs, *** = $p<0.001$, ** = $p<0.01$

To determine the extent to which Web ability and discontentment mediated the effects of age and education on Web interest, structural equation modeling (SEM) using LISREL VIII program was employed (Joreskog & Sorbom 1993). Models with $\chi^2 < 2.\text{df}$ (Akaike 1987), RMS< .05 and overall fit indices >0.9 were considered adequate fitting models. Analysis began with the specification of a measurement model where the constructs are correlated to one another. The specified measurement model included some correlated measurement errors of variables that represent the same constructs. This measurement model had an adequate fit with $\chi^2(233) = 465.05$.

Next a series of structural equation models was performed in order to determine the pattern of relationship between constructs that will most parsimoniously reproduce the pattern of covariation in the measurement model.

The first structural model was the Ellis and Allaire model (see Fig. 1a). The fit of this model was adequate: $\chi^2(235, \underline{N} = 600) = 466.06$ and it was not significantly different from the initial measurement model: χ^2 diff(2) $\underline{N} = 600) = 1.01$. However, several path coefficients were insignificant. Several nested model tests were conducted. The final model is depicted in the right figure in Fig. 1. The model largely replicates the hypothesized model except that Web Discontentment fully mediates Web Ability, age and education. The hypothesis was supported.

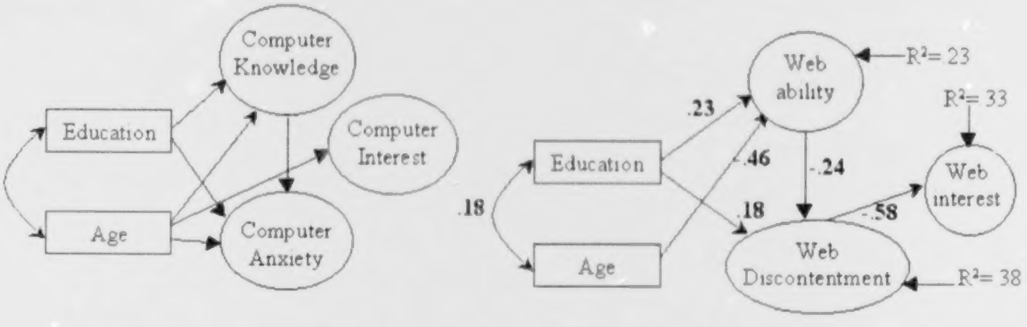

Figure 1: Hypothesized/Ellis-Allaire model (left) and final model (right) of Web Interest

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Design and Development of a Distance Education Paradigm for Training Computer Forensic Examiners

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Abstract: This paper introduces a work in progress to design and develop distance training for computer forensics examiners. Computer forensic analysis consists of a thorough and painstaking examination of digital evidence in all formats. This evidence may take the form of digitally stored documents, photographs, sounds, motion pictures, spreadsheets, databases, Internet history files, or any other recording in digital form. The computer forensics examiner must be able to retrieve these documents or recordings after they have been deleted, fragmented, and/or encrypted. This requires the examiner to have a diverse set of both technical and investigative skills.

Currently, the only available reliable sources for computer forensic training are in-residence courses provided by the U.S. Government and a few commercial companies. However, the rapid spread of computer technology (and conversely, computer crime) has created an extremely long waiting list for many courses with some students being refused admission altogether. This study will focus on two major questions of relevance to the training of computer forensic examiners by distance. The first goal is to answer the basic question of what are the specific education and training objectives for computer forensic examiners? This question addresses the core skills and abilities that a basic computer forensic examiner must possess. The second phase of this study will concentrate on answering the question of what online technology can be applied to computer forensic education and training to remedy the current shortfall of trained computer forensic examiners? This question addresses the specific network and computer based training technology that can be reasonably applied to achieve mastery of the core educational and training requirements for the basic computer forensic examiner.

Project Background

Although the area of computer forensics was investigated as a subcategory of computer crime studies a decade ago under a U.S. Department of Justice contract, very little has been done to refine the concepts and structures of computer forensics during the past ten years. Some of the early reports concentrated on the points of computer crime definition and legal statutes for prosecution (Parker, Smith, Turner, & Sherizan, 1989) but neatly sidestepped the technical issues surrounding the digital evidence collection procedures that came to be known as computer forensics. Another study contracted by the U.S. Department of Justice went further by identifying police organizations that had dedicated computer crime units but still stopped short of explaining what training was provided and why (McEwen, Fester, & Nugent, 1989). Upon review of the report it becomes apparent that most computer crime officers at the state and local level were self taught with the exception of a very few who are able to get computer crime course training quotas at the Federal Law Enforcement Training Center (FLETC) in Glynco, Georgia. In still another contracted report from the same time period, the impact of computer crime is reviewed along with case studies, crime scene procedures, and investigative management but, again, the issue of training was sidestepped (Conly, 1989). The same authors that provided these reports also provided an article in *NIJ Reports*, the Journal of the National Institute of Justice, that was replete with case studies but without training recommendations (Conly & McEwen, 1990).

Project Description

Currently, computer forensic training is provided by only a handful of organizations and is reserved mostly for police officers and large corporate security professionals. Moreover, the basic training is provided only once or twice a year in limited attendance resident schools with tuition ranging from $695 to over $2,200 per student plus the expense of meals, lodging and transportation. Due to the exponential growth of computer technology and the increasing rate of change in that technology (the degree of change is increasing as the time span required for the change decreases), the technology is rapidly outpacing the ability of law enforcement and government agencies to provide qualified computer forensic examiners.

As an additional challenge, there is currently almost no research available upon which to base training course design or national training standards. Consequently, training tends to be very hit and miss with each police department, government agency, or corporate entity devising their own programs in an educational vacuum. This ad hoc training structure further impedes the forensic investigative process by not providing a common training background for interagency cooperation.

The National Cybercrime Training Partnership is currently attempting to draw police, corporate, and educational partners together to formulate a national training standard for computer forensics. However, this effort is also impeded by a lack of baseline information relating to the computer forensic training challenge. To date no research has been compiled to document the who, what, where, how and why of the various computer forensic training programs. This leaves the current standards committee in the position of compiling standards without the benefit of specifications.

Defining Specific Education and Training Objectives for Computer Forensic Examiners

By examining the training plans, position descriptions and employee backgrounds of major government and civilian computer forensic establishments and distilling the basic competencies, this research will identify computer forensic core skills and abilities. These skills and abilities will then be translated into an event-response list. Using the event-response list, event and primitive diagrams will be constructed to identify the core tasks vital to the computer forensics process. Appropriate education and training will then be identified to support the core tasks. As a validation step, the final computer forensic training diagram will be submitted to the computer forensic community for critique.

Application of Online Technology

Once all training and education requirements have been identified and diagrammed, appropriate online technology will be identified to provide a distance learning environment that is accessible as well as technically and educationally sound. Initial research has shown that virtual environments and intelligent pedagogical agents may play a significant role in this phase of the project.

Overcoming Traditional Barriers to Computer Forensics Training Research

Barriers to the proposed research have traditionally centered on a lack of integrated educational and technical expertise within the computer forensic field. Traditionally, computer forensic training has been developed and implemented by law enforcement personnel on an ad hoc basis. This has created an environment where the accepted educational and training standards and methods are seldom examined or validated from an educational perspective.

An additional issue that has traditionally served to impede a study of this nature is that of protecting law enforcement sources and methods involved in computer forensics examinations from becoming public. This research project proposes to avoid this controversy by examining only forensic education and training requirements and methods, not specific forensic tools and procedures.

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Analytical and fuzzy Student and Document Modeling for Adaptive Educational Hypermedia System

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Abstract: CAMELEON is the English acronym of Computer Adaptive Medium for LEarning On Networks, It's a system running across the Internet / Intranet, allowing teacher introduce his/her course and helping the learner to study it (presentation of the course materiel, assessments, etc.) via an adaptive hypermedia interface. We discuss in this paper the tutoring part and more precisely how the system model student and document.

Adaptive hypermedia is usually related to user or student model and so we generally display pages depending on this user model. In our system we take into account two parameters: level of knowledge and the learning style preferred by this student based on the FELDER learning style model.

We associate a matrix to each document, the matrix is composed of related signatures to elementary document fragments, and student profiles are modeled via a matrix composed by different values of learning styles and level of knowledge.

Each entry in the matrices is a probability and so we use fuzzy logic to maintain and update the student model.

Keywords: Adaptive hypermedia system, user modeling, , fuzzy logic

I. Introduction

One of the advantages of computer based approaches in educational hypermedia is the one-to-one correspondence between students and machines facilitating individualization of learning.

An educational hypermedia system should continuously adapt its display to the need of the student in accordance with the knowledge domain.

Student modeling is a form of assessment which was developed to allow Adaptive Hypermedia System (AHS) decide which content or link to display to the student, when to interrupt, what level of explanation to give and so on. [7].

Basically, the crucial task of the AHS is to determine the next action in accordance to the student behavior.

Most of the approaches dealing with student modeling (overlay modeling, perturbation modeling, bounded user modeling, etc.) involve a rather simplistic model of the learning process.

This type of model doesn't take into account of the wide range of learning styles and capabilities, which diversity was largely demonstrated by a number of psychologists. It also ignores the individual differences between the students. Moreover, neither the student nor the teacher can infer with the student model to adapt it to specific learning styles.

In this paper we present a framework for the development of a student model mainly based on the FELDER model.[3] This model has 2-tier structure.

Firstly, it is a fine-grained model for deciding which type of content to display (Text, Images, Simulation, etc.)

Secondly, it works as a coarse grain model to reflect whether the student has or has not mastered a course material presented.

The model keep records of a tutoring session and uses them to update the teaching strategy for the particular need of the student.

This model is used in a proposed adaptive hypermedia system called CAMELEON [4]

II. Presentation of CAMELEON

CAMELEON is the English acronym of Computer Adaptive Medium for LEarning On Networks, It is a system running across the Internet/Intranet, allowing teachers introduce their course and the helping the learner to study it (presentation of the course materiel, assessments, etc.) via an adaptive interface. [4]

A separate system would then present the teaching to the student.

Via the system, teachers will be able to split the course in fragments which can be either composite or elementary (image, video subsequence, text, etc.).

They can also supplement each fragment with comments concerning the category of students (visual/verbal, active/reflective, sensitive/intuitive, sequential/global) and knowledge level required for this portion. This signature is added as a tag to the HTML fragment file, all those fragments are stored as objects in an OODBMS. The tutoring part will then deliver the suitable course to the student.[LAR 99]

III. Analytical Method for Student and Document Modeling

III.1 The student Model Components

It is a well-established fact that there are significant individual differences in school performances due to different background and learning skills. Ideally this should be modeled so that an AHS may present the material to be taught as to meet individual learning capabilities and perhaps remedy same weaknesses.

In order to achieve this, the student model must record information with respect to:

- Knowledge level
- Cognitive capabilities (memory limit, learning strategies, etc.)
- Metacognitive skills (understanding, use of the feed back, etc.)

All this information can be fed back from learners while they work to master a subject they acquire or improve knowledge and skills. This can be mapped into the student model.

In our model we use three types of questions:

- Factual questions: questions to test the knowledge of elementary facts and topics directly related to the current session.
- Learning strategy questions: FELDER psychological test to classify students in visual/verbal, sensitive/intuitive, active/reflective and sequential/global.
- Personal questions: to identify students and customize their work environment.

III.2 The Student Model Entries.

To model the learner we use a [2n,1] matrix which entries are the student associated learning styles and knowledge level. Where n is the number of learning strategies plus the knowledge level

The order is important so we set p_0=visual, p_1=verbal, p_2=sensitive, p_3=intuitive, etc. we note that the student can either be visual or verbal, active or reflective, etc and so we allocate 1 or 0 to each characteristic.

For the knowledge level we allocate the following values, 01 to beginner, 10 to intermediate and 11 to expert.

Example

P1	*P2*	*P3*	*P4*	*P5*	*P6*	*P7*	*P8*	*P9*	*P10*
1	0	0	0	1	0	1	0	1	1
Visual	*Verbal*	*Sensitive*	*intuitive*	*Active*	*reflective*	*sequential*	*global*	*Know. level*	

This student is visual, active, sequential and expert.

III.3 Modeling the Document

Type of learning strategy on 8 bits

Level of knowledge on 2 bits

Our document is divided on HTML fragments or blocks according to teachers need (figure 2).

To each fragment we associate a signature according to the following model

B10							B3	B2	B1

The order in the signature is important and it follows the same sequence given by the learner model of in this case B10 is for visual attribute, B9 is for verbal etc.

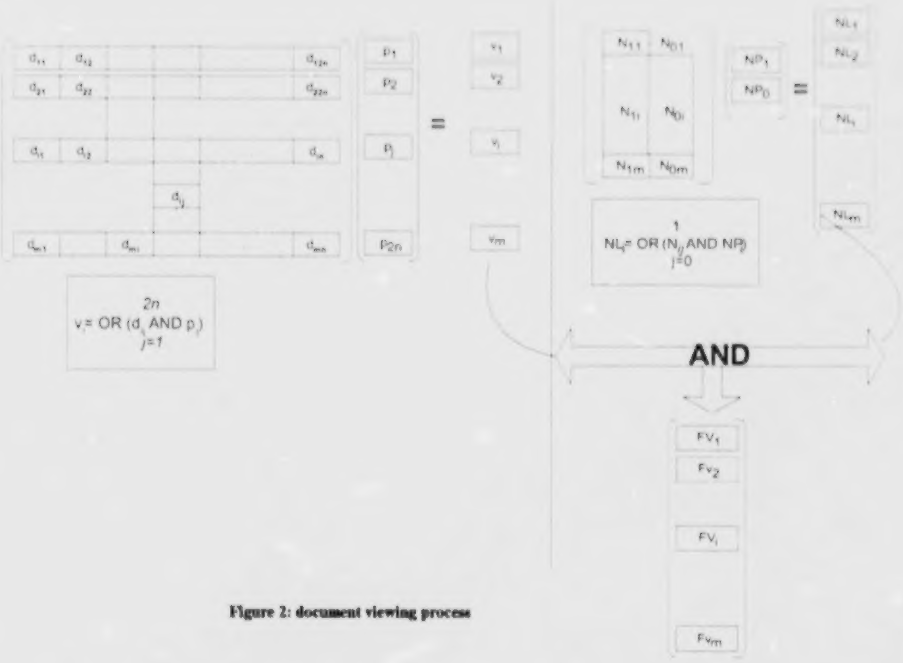
S01	S02	Signification
0	0	Block not reserved to S01 nor to S02
0	1	Block reserved to S02
1	0	Block reserved to S01
1	1	Block reserved to S01and to S02

S01 and S02: dual learning strategies.

B2	B1	Level
0	0	Prerequisite
0	1	Beginner
1	0	Intermediate
1	1	Expert

We divide the signature in two parts; one for the learning strategy and one for the knowledge level, we apply this to the entire document and we obtain two matrices (figure1)

The set of all signatures give us a [2n, m] matrix, where m: is the number of fragments and n: for the number of learning strategies plus the knowledge level(figure3)
We binary multiply these two matrices by the matrices relative to the student profile divided in the same manner, we obtain two arrays, once "ANDed" with each other give an array reflecting a viewing decision of this fragment (1 if yes, 0 if not) (figure 2)



d_{11} d_{12} d_{12n}
d_{21} d_{22} d_{22n}
d_{i1} d_{i2} d_{in}
d_{ij}
d_{m1} d_{mi} d_{mn}
p_1 p_2 p_j p_{2n}
=
v_1 v_2 v_i v_m
$v_i = \mathrm{OR}_{j=1}^{2n} (d_{ij} \text{ AND } p_j)$
N_{11} N_{01} N_{1i} N_{0i} N_{1m} N_{0m}
NP_1 NP_0
=
NL_1 NL_2 NL_i NL_m
$NL_i = \mathrm{OR}_{j=0}^{1} (N_{ij} \text{ AND } NP_j)$
AND
FV_1 FV_2 FV_i FV_m

Figure 2: document viewing process

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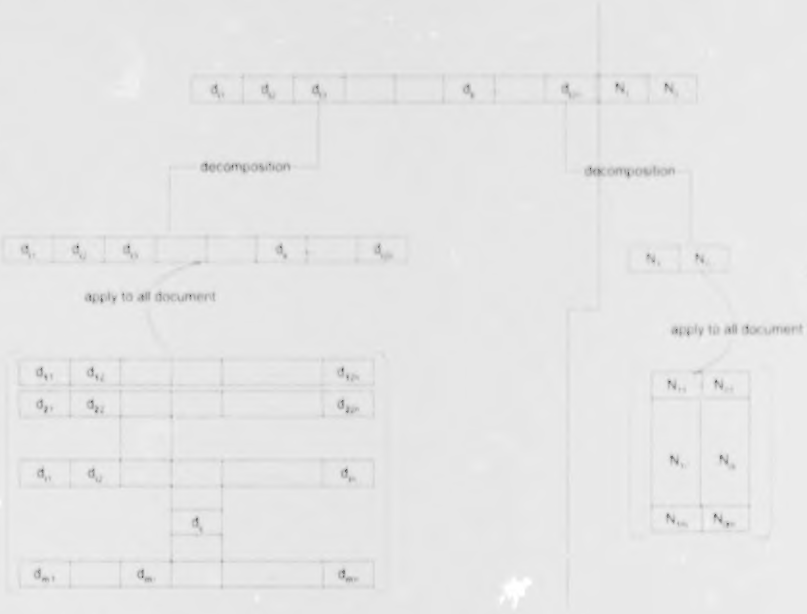

Figure1: signature decomposition and the application to the entire document

III.4. scenario of interaction

- Teachers introduce their courses via an authoring tool, another tool offers to those teachers or to another group of teachers the possibility of dividing document on elementary or composite fragments. To those fragments teachers add a pedagogical signature reflecting it's final destination (the profile of the student, the knowledge level).
- Students are divided in two categories, subscribed or unsubscribed, unsbscribed student fill an information sheet and a questionnaire making possible their categorization (*Visual, Verbal, Sensitive , intuitive, Active, reflective, sequential, global)*
- matrix representing document and student are generated (see III.2 and III.3) and an operation between those two matrices permits to know the elements to be displayed to the student (see figure 3)

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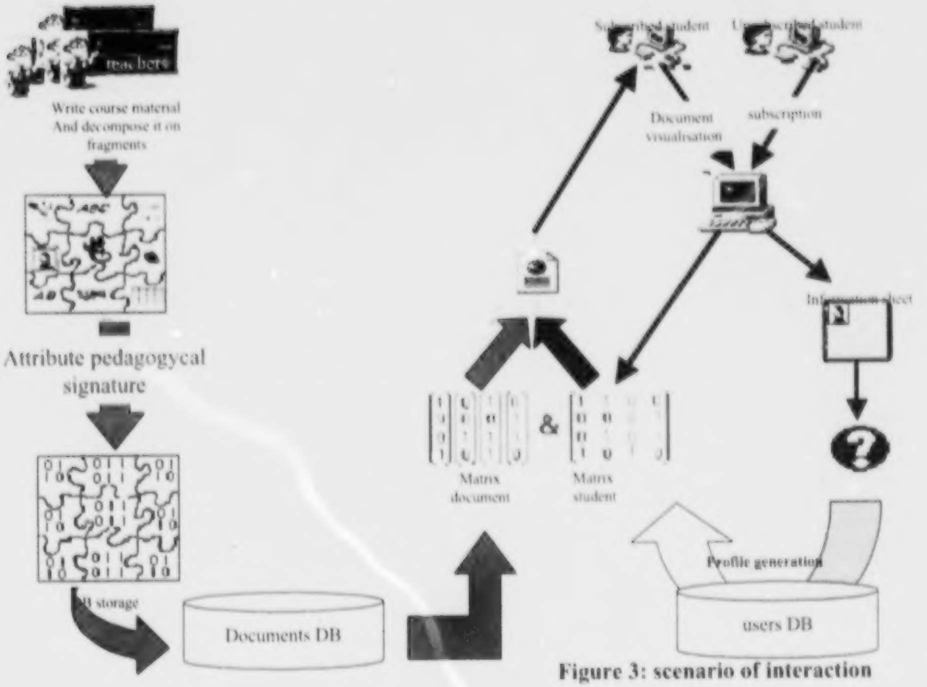
teachers
Write course material
And decompose it on
fragments
Attribute pedagogycal
signature
DB storage
Documents DB
Subscribed student
Unsubscribed student
Document
visualisation
subscription
Information sheet
&
Matrix
document
Matrix
student
Profile generation
users DB

Figure 3: scenario of interaction

IV. Using fuzzy logic in Student and document modeling

IV.1 Student Modeling

In general each element in the model is an uncertain variable which can be treated as a fuzzy variable (in the sense of fuzzy set theory).

First we create, a fuzzy subsets A_i of a universe of discourse U which are characterized by a membership function p: U→ [0, 1]. This function associates with each element y of U, a number p in the interval [0,1], p will be defined later.

The FELDER test permit to classify learners according to a scale ranking from de 1(X_min) to 11(X_max) (http://www5.bae.ncsu.edu/courses/bae451/ils.html)

So for modeling the learner we take the value X given by FELDER test we subtract the minimum and divide the result by the maximum minus the minimum, so for a learner obtaining x= 7 in strategy S1, we have

$$\boxed{p=(x-min)/(max-min)=(7-1)/(11-1)=0.6}$$

We allocate to this student 0.6 for strategy S1 and 0.4 for strategy S2.

The same thing is done with the knowledge level, we give a value between 0-10 that we divide by 10 and so we obtain another fuzzy value, we associate an array to this student profile containing these elements.

IV.2 Document Modeling

The teacher provide its commentary by fixing a value between two learning strategies or between two knowledge levels, we associate to this value a probability.(this feature is implemented through a button widget).

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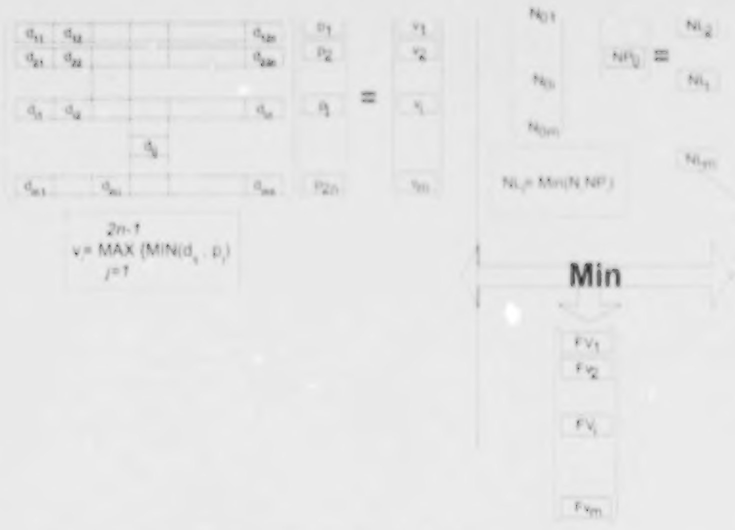

Figure 4: process of document viewing using fuzzy logic

We apply the same process described above (3.2) excepted that we perform a MAX instead of OR and MIN instead of AND. The result is an array giving a view on all documents and we display fragment having a probability exceeding a threshold fixed before. (Figure 4)

V. Updating and Maintaining User Model

We have to manage in student model two components: Knowledge level and learning strategy. For updating this two data we use information supplied by the session records such as for the knowledge level: total learning time needed, number of attempts to find correct answer, time elapsed between two successive courses [2], results on given exercises.

All these are recorded during interrogation of the student through different questions and the values are used to readjust values given in the profiles.

We associates to these values a formula

$$\boxed{(x * t1 + y * NA + Z * t2 + T * r) / X * Y * Z * T}$$

- t1: total learning time needed
- NA: number of attempts to find correct answer
- t2 time elapsed between two successive courses
- R: results on given exercises.
- X, Y, Z,T are coefficients fixed beforehand.

The same quantification is used for the course constructed and the type of exercises.

For updating the classical model we use the results of the formula, if it exceeds, a threshold value we reverse the binary value.

For the fuzzy method this value is either added or subtracted to the elements of the profile.

VI. Conclusion

In this paper we describe a methodology which involve the use of matrices in order to model users and documents and the use of probability values as entries; the use of fuzzy logic is useful in this case because it give us the possibility to handle fuzzy values.

We think that this work offers an effective approach to an adaptive educational hypermedia system based on the utilization of individual student differences, in order to update teaching strategies and presentation of content to individual students needs.

This work is under development, future work will include the experimentation of the prototype in order to better express the formula updating the student profile and to better adjust coefficients.

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Using Web-Based Testing in Support of Corporate Training

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Abstract: The paper describes a Java-based, Oracle-backended testing tool to deliver secure, interactive, Web-based tests. The tool supports test generation, delivery, automatic grading, real-time student feedback, and test analysis/reporting via the Web. The paper focuses on the tool's extensive student feedback and reporting features.

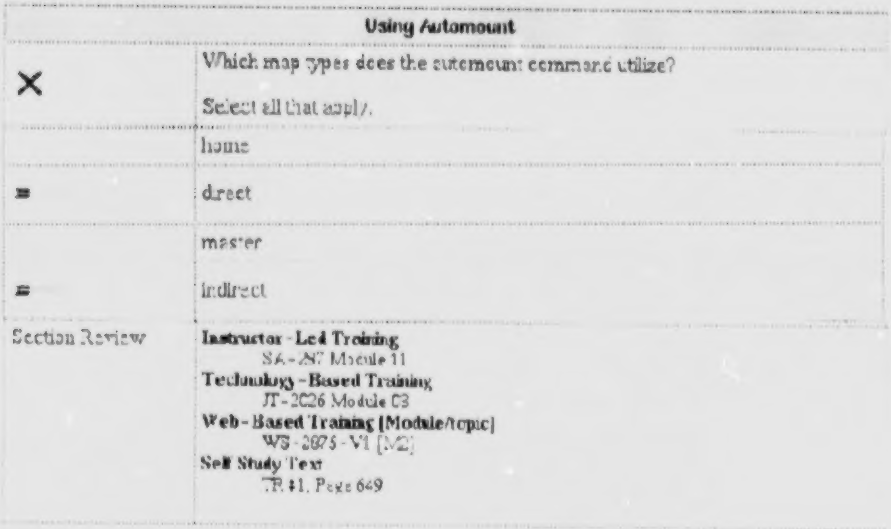
Introduction

The World Wide Web has shown great promise for distance education. Web-based training and testing systems offer multinational, technology-based corporations a way to effectively deliver, manage, evaluate, track, and customize employee training. To companies that compete in the Internet economy, employee training in new technology has become increasingly important and urgent. A well-trained workforce provides a competitive advantage to any large corporation.

In early 2000, Sun Microsystems' Sun University implemented a Web-based testing and educational tool to help train Sun's IT (information technology) workforce. The tool was developed to address two important areas of learning: assessment and feedback. It's main goals are to quickly and accurately assess students' knowledge of the IT subject areas related to their job and to direct students to a customized learning path that will allow them to gain the knowledge required for their job in the shortest amount of time.

Description

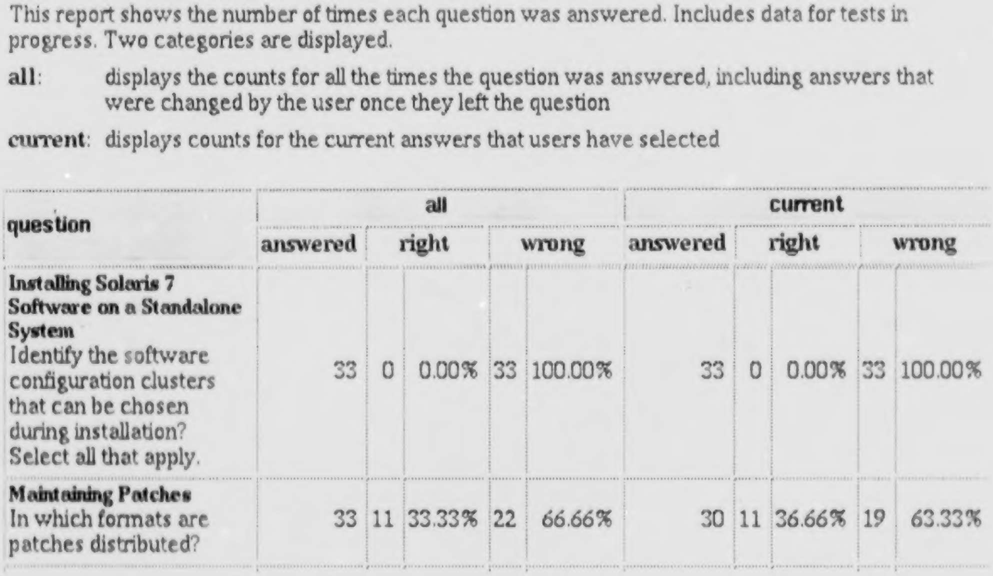
The tool consists of a Java client, a Netscape 4.1 server, and an Oracle database. The program provides three types of questions: (1) multiple choice, (2) multiple correct (select all that apply), and (3) true/false. The tool uses the highest level of technology to create an advanced testing environment.[1] The test is generated from the database and is delivered to students via a Java-enabled browser. Once a student has answered all the questions and submitted the test, the tool provides immediate grading and feedback. For each wrong answer selected by the student, additional learning resources given as feedback link the student directly to relevant learning events (figure 1).



Using Automount	
×	Which map types does the automount command utilize? Select all that apply.
	home
■	direct
	master
■	indirect
Section Review	**Instructor - Led Training** SA-287 Module 11 **Technology - Based Training** JT-2026 Module 03 **Web - Based Training [Module/topic]** WS-2875-V1 [M2] **Self Study Text** TP #1, Page 649

Figure 1. Learning resources feedback

The analysis/report functions of the tool provide a distribution of test scores and statistics by question and by subject areas (figure 2). These reports allow instructors to monitor student progress and can also be used as a tool to refine test questions and course content to ensure that learning objectives are met.



This report shows the number of times each question was answered. Includes data for tests in progress. Two categories are displayed.

all: displays the counts for all the times the question was answered, including answers that were changed by the user once they left the question

current: displays counts for the current answers that users have selected

question	all					current				
	answered	right		wrong		answered	right		wrong	
Installing Solaris 7 Software on a Standalone System Identify the software configuration clusters that can be chosen during installation? Select all that apply.	33	0	0.00%	33	100.00%	33	0	0.00%	33	100.00%
Maintaining Patches In which formats are patches distributed?	33	11	33.33%	22	66.66%	30	11	36.66%	19	63.33%

Figure 2. Test report

BEST COPY AVAILABLE

Conclusion

This version of the Web-based testing tool has been in use at Sun Microsystems since January 2000. The tool has proven valuable in assessing the knowledge of the corporation's IT workers and assisting them to efficiently gain new skills to meet their ever-changing job requirements.

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Quality Assurance Strategies for Online Delivery Program Delivery

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Abstract: Emerging Internet technology is enabling universities to offer courses in an anywhere, anytime environment. This new teaching modality finds students viewing their universities as more responsive to their lifestyle needs, actively involved in their learning and empowered to assume the role of life long learners. Faculty find themselves cast into an altered teaching environment that requires them to be much more facilitative by individually supporting their students. The purpose of the article is to discuss several Quality Assurance Strategies (QAS) for ensuring quality online teaching and learning. These strategies are organized around five program areas: administrative leadership and support, ongoing program concerns, course development, student concerns and needs, and faculty development.

Introduction

As institutions of higher education work toward developing online programs, issues of quality assurance strategies surface. The Council for Higher Education Accreditation (1998) defines "... "quality assurance in distance learning as the means by which institutions or providers set their program goals and measure results against these goals" (p. viii). This article will discuss several Quality Assurance Strategies (QAS) for ensuring quality online teaching and learning.

Administrative Leadership and Support

The administrative QAS involves establishing an organizational infrastructure for online learning. This structure provides technical assistance, opportunities for research and evaluation, and external and internal funding opportunities. These administrative mechanisms help instructors understand how their online activities correspond to strategic initiatives of the university. Clearly, the primary QAS for online programs is an administrative and technological infrastructure that is well understood and embraced by those who will be delivering the online program.

Ongoing Program Concerns and Needs

The decision to put a program online involves discussion, planning and evaluation at several levels. The QAS at this point include approval and support of the College and Department administrators and developing and presenting a plan defining the direction the online program will take. The Program Coordinator should plan and develop the online program needs based on standards and guidelines established by accrediting associations as well as National and State professional organizations. Key support personnel such as instructional designers, programmers and technicians should be identified and contacted. Ongoing evaluation of individual courses as they relate to the overall program is needed in order to maintain continuity across the curriculum. QAS to considered for evaluative purposes include comments from outside reviewers, student input and evaluations, current online research, and professional journals.

Course Development

Course development is a team process that consists of subject matter experts (faculty), instructional designers, web programmers, and graphic artists working together. Courses are originated by the faculty offering the courses and reflect the content, interaction, assessment, and other functional aspects determined by the faculty member. QAS are paramount in the development of pedagogically sound online courses. A comprehensive analysis of an online course as it relates to the program should be conducted. Issues such as course prerequisites, sequencing of courses within the program, assessment instruments, and pedagogical methodologies and strategies are considered.

Student Concerns and Needs

An important QAS for online instructors is understanding the motivating factors that prompted the student to enroll in an online course. Another QAS is to quickly establish a line of communication between the instructor and the online students once the course has started. Hearing from the instructor is reassuring for students taking an online course for the first time.

Faculty Concerns and Needs

Several QAS should be available for online faculty to ensure a successful online experience. These include faculty development opportunities that provide training and resources as well as funding for student assistants, multimedia computers and course release time.

Conclusion

Successful delivery of Web-based programs depends on developing and integrating Quality Assurance Strategies into the total online process. These strategies provide the framework for the design, development, implementation and management stages and ensure a successful experience for faculty and students.

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A Web-Based Homework Environment Providing Students with Feedback, Incentives and Interactivity

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Abstract: We have developed a prototype web-based homework environment (Homework Tutor) for delivering a physics homework assignment. The prototype provides students with feedback, incentives and interactivity while addressing known difficulties of the topic chosen. The questions are provided in an inquiry-based format. Students can manipulate the different physical parameters before answering the questions. The scoring scheme provides the students with incentives for improving their scores and completing the full assignment. The homework tutor is intended for college level classes but can still be used for other levels of instruction and with other subjects.

I. Introduction

Research has shown improved student learning when meaningful homework assignments are completed successfully and then returned to students with constructive comments [Butler 1987]. Homework is usually given to complete unfinished class work, provide additional practice, use outside resources, and learn topics related to the ones covered in class [Bryan 1997]. Student benefits from completing homework include learning to work independently, and developing self-discipline and responsibility [Learning Partners 1995].

On the other hand, especially in large enrollment university classes, time constraints often lead frustrated teachers to either not assign homework or just assign "busywork" type problems. Feedback, when provided, is often delegated to inexperienced graduate or undergraduate assistants. Recent advances in Web Technology are leading many teachers to try to overcome these shortcomings by using the Web in delivering homework. Several companies are capitalizing on this need and are providing software for homework delivery [URLs].

However, most of these homework delivery mechanisms provide only an automation mechanism to the delivery of traditional text-based homework. Feedback is usually limited to automated standard notes or examples of completed correct assignments. Believing that a web-based homework delivery mechanism will be more effective if it provides the student with more feedback and an opportunity to test their knowledge, we have developed a prototype web-based environment (Homework Tutor) for delivering a physics homework assignment. The environment includes a mechanism for providing students with feedback, incentives and opportunities to experiment with the physical parameters that the physics question addresses.

II. The Homework Environment

The topic chosen is two-dimensional motion, one of the first hard topics that students learn in introductory college physics. The difficulty in the topic we have chosen stems from the fact that students have to learn to separate the two dimensional components of the motion. For instance, it hard for them to understand that acceleration along the vertical does not affect the horizontal component of the velocity [Aaron 1997]. By using multimedia, we can show students the different components of the motion separately. We can enable them to compare the effect of each of the motion parameters on each of the motion components. We can help them discover how these parameters affect the combined motion while not affecting some particular element(s) of the motion. The topic is ideally suited for the use of multimedia.

The homework tutor is made up of three components, instruction on the use of the different components of the tutorial, an introduction to each of the subtopics covered and an interactive quizzing component. The instructions are easily accessible throughout the tutorial. The introductions to the topic and subtopics include vivid images and animations depicting real life applications of the concepts covered. The quizzing component is made up of a set of questions addressing all key points (sub-topics). For each question, a Java applet provides an interactive environment enabling students to modify the different parameters involved in the motion (like the angle of the initial velocity, initial x-velocity, initial y-velocity, initial x-displacement, initial y-displacement, acceleration), view the effect of their choices, make any necessary modifications, then answer the question. The questions methodically address the known areas that students find difficult. Each question appears separately on a frame that includes the simulation, input boxes, and control buttons. The input parameters and control buttons depend on the particular question. Students should be able to access the questions sequentially. However, a tutorial Map will enable them to navigate freely through the questions. The homework tutor is designed such that the numbers in most of the provided questions take random values. This means that the answers are going to be different for every student and different every time a student accesses the same question. This will help motivated the students to focus on the concept involved rather then the numbers.

To help encourage students, the question screen includes a graphics showing their current score and the level of "proficiency" reached. The top five scores are available through the click of a button, providing the students with an opportunity to compete. Scoring will depend on the difficulty of the question, the time on task, and the deadline. To promote better student performance, the score will not have an upper limit. To foster a positive environment the score will not include punitive actions. Furthermore, students can improve their scores by redoing missed questions.

The homework tutor will keep a detailed record of student performance. The records will track individual students and overall student performance on each of the questions. Some of the information that will be tracked is time on task, and the elements (buttons, or hot spots) of the question frame that the student has used. Furthermore, by comparing student performance, the homework tutor will identify possible problem areas and point them out to the professor. This will enable the professor to provide hints and address the problem areas.

III. Technical Details

The homework tutor is run on an Intel-based server using the Windows NT 4.0 service pack 5 operating system. The web server is Microsoft's Internet Information Server version 4 with O'Reiley's Perl for win 32 installed. The homework tutor was designed using a combination of Perl, Java, and JavaScript. The Perl programming language is used for tracking student performance, calculating and comparing scores, and determining the various programmatic decisions. It is also used to generate the dynamic student interfaces and the teacher interface. Java and JavaScript are used to provide the interactive components in the student interface. The simulations are made in Java and controlled with JavaScript. JavaScript is also used to track the student's interaction when using a particular frame.

IV. Summary

The homework tutor included a mechanism to provide students with feedback, incentives and interactivity. We believe that it will improve student learning of this particular topic and their attitude about learning. The design allows for close monitoring of student performance, time in task, and interaction while in task. The data will be useful in determining the effect of the various elements of the tutorial. If proven useful, the design used for this homework tutor can be adapted to many more topics in physics and other subjects. Tests on the effectiveness of the homework tutor will be made during the fall 2000 classes.

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Using the Internet in Teaching Translation: Learning from Failures

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Abstract: This paper will demonstrate and analyze the use of free on-line dictionaries and translation software as resources for practical translating. More importantly, it will also show how these resources, specifically Machine Translation systems, can be used as a teaching tool to exemplify theoretical points in an upper division translation or linguistics course. The focus will be on translating into English to make the paper accessible to a wide audience.

Introduction

First, and although the necessity may come as a surprise for those not involved in foreign language pedagogy, I will show how the introduction of translation into the foreign language curriculum can actually be reconciled with the goals of undergraduate language instruction. According to the American Council of Teachers of Foreign Languages (ACTFL), "All Americans should be proficient in at least one language and culture in addition to English."[1] Undergraduate foreign language training typically aims at the development of functional competency, i.e. the ability to accomplish linguistic tasks in the target language. Translation is mostly excluded from the classroom. Now consider the summary of some of the *ACTFL National Standards for Foreign Language Learning: Preparing for the 21st Century*, which include the following (see www.actfl.org):

> CULTURE: Students gain knowledge and understanding of other cultures by demonstrating an understanding of the relationship between the practices, products and perspectives of the culture studied (standards 2.1 and 2.2).
>
> CONNECTIONS: Students connect with other disciplines and acquire information through the foreign language and recognize the distinctive viewpoints that are only available through the foreign language and its cultures (standards 3.1 and 3.2).
>
> COMPARISION: Students develop insight into the nature of language and culture through comparisons of the language and culture studied and their own (standards 4.1 and 4.2).

Surprisingly, the role of the theory and practice of translation as a tool to achieve these and other standards is often overlooked. However, it is my conviction that not only does the teaching of translation facilitate the development of these standards, but that translation can be used as an assessment tool for the accomplishment of certain standards.

Translation as a Process

Translation skills are not an automatic by-product of learning a foreign language or being bilingual. Translation is a highly complex process; the input is a text written in a source language and originating in a particular culture; the output is a text in a different language intended for another culture. Translators consciously use their linguistic and cultural knowledge, as well as plain common sense to make appropriate decisions in order to produce a satisfactory text. The fundamental unit of translation is the text, and at the macro-level such features as function and register, which normally remain constant across two languages, are analyzed so that they can be faithfully reproduced in the target language. At the micro-level the translator deals with the individual elements of the text – words, phrases, sentences. Here the translator has access to many aids: dictionaries, reference works, grammars, model texts, etc. The well-informed use of on-line aids, such as the multi-lingual dictionary at *dict.leo.org*, as well as other on-line reference works and search engines can considerably help translators in their work.

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[1] Vision statement adopted by the ACTFL Executive Council, September 1997.

Translation Software

The field of Machine Translation (MT) has come a long way since its beginning stages in the 1960s. By now, linguistic knowledge (especially on the levels of morphology and syntax) can be represented with fairly good success in computers, and the seemingly endless amount of memory a computer has to offer, combined with its incredible speed of retrieval are impressive. I will demonstrate how MT systems, such as *Babelfish*, offered free by the pioneer MT company *Systran* at *babelfish.altavista.digital.com*, can handle rather complex paragraphs of up to 50 words, providing surprisingly acceptable translations from German into English and back. Here is an example:

> German input:
> Übersetzungen sind schwierig. Wörter sind oft mehrdeutig. Redewendungen können nicht wörtlich übersetzt werden, weil ihre Bedeutung nicht gleich der Summe der einzelnen Wortbedeutungen ist. Begriffe sind kulturspezifisch. Auch wenn man die Sprache gut beherrscht, kann man dumme Fehler machen.
>
> English output:
> Translations are difficult. Words are often ambiguous. Idioms cannot be translated literally, because their meaning is not equal to the total of individual word meanings. Terms are often culture specific. Even if one knows the language well, one can make stupid errors.

When Machines Go Wrong: Teaching and Learning Through Failures

However, it is the innately human real-world knowledge and common sense input to the translation process, as well as the *conscious* decision process that make the human translator far more reliable than the fastest software. The sorting out of ambiguities at the word-level (for instance, homonyms such as "I have money in the *bank*" versus "I had lunch on the *bank*"), and the syntactic level (for instance, the pronoun reference in "I went to the bar to have a beer but *it* was closed" versus "I went to the bar to eat a hamburger but *it* wasn't fresh") usually does not pose a problem to humans. It is something we do more or less automatically in our native language. For machines, such decisions of disambiguation are the ultimate challenge. The example above may seem complicated at first, but for the purpose of translation it is really quite straightforward, with a limited vocabulary and no ambiguities. It is easy to show how things can and do go wrong. For example, the German idiomatic expression "Du hast ganz schönes Schwein gehabt" ("You were quite lucky") was rendered by *Babelfish* as "You had quite beautiful pig". The advertisement "Nichts saugt wie ein Elektrolux" ("Nothing vacuums better than an Elektrolux") was translated as "Nothing sucks like an electrical lux". Even deceptively simple translation requests can produce results that range from awkward, to funny, to outright nonsensical. For example, the sentence "Ich habe meinen Papagei gern" ("I like my parrot") produced "I have mean parrot gladly" (see Budiansky 1998 for a description of *Babelfish* and examples in other languages).

Crucially for the teaching of translation, the reasons for successes and failures of on-line translation aids can be analyzed in the context of what students should know about the structure of language and the complexity of the mental activity "translation". Once students are able to define the error source at the different structural levels of linguistic organization and are able to intentionally and predictably mislead the Machine Translation system, they will probably also be more aware of similar pitfalls in their own translations.

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Being There: Search Engine Positioning on the World Wide Web

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Abstract: Intense competition among the owners of commercial Web sites to attract visitors has led to the emergence of search engine positioning firms. This study examines the positions these firms achieve for their own sites using the strategies they sell to site owners. Surprisingly, none of them manages to maintain top ten positions across the major search engines over time. This finding highlights the complexities of search engine positioning, and shows that there is no silver bullet for winning high ranks on the World Wide Web.

Introduction

Approximately 83% of the sites on the World Wide Web contain commercial content (Lawrence & Giles, 1999), with the owners of these sites being largely dependent on search engines for driving consumers to them. Unfortunately, it is not enough for a site's pages to be included in a search engine's index. A query may generate thousands of links to Web pages. Those pages whose links appear on the first page of results, and are therefore in the top ten, are the most likely to be viewed (Silverstein, Henzinger, Marais, & Moricz, 1998; Spink, Chang, & Goz, 1999). Search engine positioning firms offer promises of placing clients' pages in the top ten across the most popular search engines for any chosen keyword. This paper describes various techniques used for achieving high rankings. It then looks at how successful the positioning firms are at placing their own sites in the top ten, given their large incentive for "being there." Their success, or failure, reflects the feasibility of winning the positioning game.

Positioning Techniques

A variety of factors effect the rating a page earns in response to a query submitted to a search engine, including the frequency with which the query terms appear in the page, their presence within the page's title tags, and, for some search engines, their appearance in META tags. If query terms appear near the top of a page or in close proximity to each other, then rank will also be positively effected. A page perceived as being of high quality, including pages that serve as "authorities" by linking to many other high-quality sites, those with high "link popularity" (i.e., with several popular pages pointing to them), and pages with high "page popularity," as evidenced by the number of visitors they receive, will earn higher ratings as well.

The proprietary ranking algorithms used by search engines may change at any point, so that a page earning a high rating one day may no longer earn that same rating the very next day in response to an identical query. Even worse, a page may mysteriously disappear from a search engine's index. It is with understandable frustration that site owners turn to positioning firms for help in obtaining and preserving high rankings.

Positioning firms advertise their ability to optimize HTML code in order to place Web sites in the top positions in major search engine listings on queries for owner-specified keywords and phrases. Given that different tag formatting, page lengths, and content may be required to successfully target each of the major engines, the firms create separate "doorway pages," which are front pages to a site that have been optimized for one or more of the search engines. A "hallway" page may then be used to link to all the doorway pages. Another common technique for enhancing rankings is to add links to related Web sites, which also link back to the originating site. Referred to as "reciprocal linking," this technique can improve a page's ranking by increasing both link popularity and the page's value as an authority.

Once a Web site has been completed, the positioning firm submits the hallway page to the major search engines. The engines should then spider and index all the pages linked from the hallway page, although some may require individual submissions of every page in the site. The desired result is that the doorway pages will receive high rankings by those search engines for which they have been optimized, so that links to at least one of those pages will appear in the top listings across all the major search engines. Continual maintenance will then be required to maintain the positions of those pages.

Relative Success in Positioning

Search engine positioning firms, which have a vested interest in maintaining top ten positions for their own sites, provide an ideal test case for determining the effectiveness of the techniques described in the previous section. Five of the most-visited search engines were chosen for this study: AltaVista, Excite, GO.com (formerly Infoseek), HotBot, and Lycos. A query on the term "positioning" and the phrase "search engine" was submitted to each of the search engines for finding the top ten positioning firms. The queries were run on three separate occasions to determine if the firms that were originally listed in the top ten would maintain those positions over time. The queries were first submitted in July 1999, were resubmitted in August 1999, and then again in March 2000. The resulting data is available upon request.

In July, a total of twenty-four firms appeared in any of the top ten positions for any of the search engines. Of those, fifteen appeared in the listings of only one search engine, and five appeared in the listings of two search engines, namely HotBot and Lycos. During July and August, both of these search engines had identical results on all queries submitted to them, so that a listing on one given a listing on the other was assured. Three firms were listed by three search engines, although for two of them, those engines included HotBot and Lycos. Only one company, Coastal Sites, had links to its various doorway pages appearing in the top ten listings for all five of the search engines.

One month later, seven of the firms no longer appeared in any of the top ten positions. A total of eleven firms, including those seven, lost at least one position. Among these firms was Coastal Sites, which lost its top ten listings on two of the search engines. Nine firms retained the same number of positions, two achieved additional listings with the same search engines for which they were listed in July, and one gained a listing from a search engine on which it had not previously appeared. By March, fifteen of the firms disappeared from the top ten positions. Four others lost listings, one maintained the same number of listings, and four gained listings. None of the firms were listed on all five search engines.

Conclusions

As both the Web and the dollars spent on goods and services purchased there continue to grow, the importance of being visible to the public escalates. The current reliance on search engine technology necessitates maintaining top positions for links to Web pages, yet even the "experts" are unsuccessful in this endeavor. Creating high-quality page content and following search engine recommendations on HTML content and registration procedures may be no less effective a means of gaining position than the additional efforts required for optimizing pages to each particular search engine. Positioning firms can only know what has been successful in the past, which may or may not be relevant to the present or future. Given the inability of any of these firms to maintain top ten positions on five major search engines for keywords relevant to all of them, it is apparent that trying to "outsmart" the search engines is a losing proposition.

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Paperless Assignment Submissions

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Abstract: As more and more students rely on personal computers and the Internet to prepare homework assignment documents, new opportunities exist for course instructors to use this electronic media rather than rely on printed copies of the documents. Paperless assignment submissions offer many advantages to the instructor including eliminating bulky stacks of paper, reducing the likelihood of lost or misplaced documents, allowing easy searching of documents to check for cheating, and facilitating distance learning initiatives.

Electronic assignment submissions can take many forms. I have tried diskettes, email, and secured network folders. However, each of these techniques suffered several drawbacks. In search of a better solution, I developed an electronic submission system that allows students to submit assignment materials to course instructors via a simple web browser. Instructors can also optionally use the system to provide feedback on graded assignments to the students.

The system, code named eSub, was originally developed to solve the problems associated with collecting student assignment files for my large (180 students) introduction to computer programming course. However, the system was designed as a general-purpose system and so can be used for courses in any topic and of any size. eSub also seems ideally suited to distance learning initiatives.

Introduction

In the spring of 1998, I began teaching a large, introductory computer programming course for the Computer and Information Systems Technology (CPT) department at Purdue University, West Lafayette, IN. For assignment work in this course, students use PCs and Microsoft Visual Basic to develop simple computer programs. Each semester this course has an enrollment of approximately 180 students. Each student will turn in 10 homework assignments, three lab exams, and one final project over the course of the semester. This results in more than 2,500 assignment submissions for this course alone. Clearly, an efficient process for dealing with this many documents is required.

In our department, students typically turn in assignment materials to clerical staff in our main office. However, this technique is less than optimal. It can result in frequent long queues at the main office door, and the clerical staff spend many hours managing the folders of paper documents. Paper documents are bulky and sometimes get lost during the routing between student, office staff, instructor, teaching assistant, and then back to the instructor, office staff, and finally the student. Furthermore, students complain that they can only turn in assignments during normal business hours when the office is open, and that they sometimes have to make a special trip to our building just to hand in an assignment.

Benefits of Paperless Assignment Submissions

During my first semester at Purdue, I began searching for alternatives to paper-only assignment submissions. Electronic submission of assignment files appeared to be ideal. We could do a better job of assessing students' work if we could run their programs rather than just read the source code from paper. Bulky stacks of folders and paper could be eliminated. We could easily create backup copies of the files to reduce the likelihood of a lost assignment. With electronic copies of all files each student has submitted, it would be easy to search for similar work and thus expose possible cheaters.

Additionally, my experience shows that computer-programming assignments are best graded using the electronic source code files the students create. Having the source code allows the person doing the grading to easily run the program, step through the source code line by line, look at the contents of variables, and so on. This method of grading produces a more accurate assessment of the students' work rather than just reading the source code from pieces of paper.

Previous Attempts at Paperless Assignment Submissions

My first attempt at electronic submissions was to require students to submit their work to me on a 1.44" diskette. Diskettes are inexpensive and so did not burden the students with any noticeable extra effort. But diskettes are not a very robust media (frequent read errors), have slow access times, can carry computer viruses, and like paper documents suffer from the same problems with long queues at the main office, are bulky and sometimes get lost.

I also considered requiring the students to send me their work via email. I know of instructors that use this approach for small classes, but email seemed unacceptable for a large course. There are too many disparate email systems that use different binary encoding techniques and some have attachment size limitations. Student assignment submissions get mixed with normal email correspondence. Additionally, students do not get immediate feedback if the assignment submission was received properly and sometimes send multiple copies "just to be sure". Even though ubiquitous, I found email to be too unstructured to be useful.

My third attempt to eliminate paper was to use secured network folders. These folders were created on a Windows NT network and a folder was created for each student enrolled in the course. Once established, this technique worked pretty well. However, establishing the folders took significant effort. This involved creating a list of all the user names for the students enrolled in the course, creating the folders, and manually assigning permissions to the folders so that only the student and the course instructor could view and change the files in the folder. Students also complained that they could not access these folders from outside the department's computer network.

Benefits of the eSub System

Owing to my dissatisfaction with the above-mentioned techniques, I developed the eSub system which is currently in use. Since I began using the system, I enjoy all the benefits of paperless assignment submissions. eSub also has none of the problems I encountered with diskettes, email, or network folders, and it has additional advantages. Its web interface for students and instructors make it accessible from anywhere there is an Internet connection. It supports an unlimited number of students and instructors. It supports any file format from any PC platform. It's much more structured than using disparate email systems (especially for large classes). Students know immediately that their files have been received and are ready for grading. Instructors can define multiple courses and multiple assignments for each course. Instructors can define allowable date and time submission ranges for each assignment. Students can use it to submit files to the instructor, and instructors can use it to send feedback on the assignment to the student. No special network administration is required since instructors and students maintain their own accounts via a web browser. It maintains an audit log of all system activity.

One feature of this system that is not present in most document sharing web applications is eSub's integrated archive program. This archive program is important because it allows an instructor to retrieve all student files for a given assignment with just a few mouse-clicks. The files from these archives can then be extracted to a local PC for off-line grading. The archive files also make it simple for instructors to keep an electronic copy of all student work as it was submitted and after it has been graded.

Conclusion

Paperless assignment submissions offer many benefits to both instructors and students. Everyday forms of electronic submission such as diskettes, email, or network folders might be manageable for small courses, but for large courses, a dedicated electronic submission system provides far more convenience.

eSub is one such electronic assignment submission system. It is now in its second semester of pilot testing in four courses, with 350 students, and about 13,000 submitted student files. Several more instructors from various disciplines are expected to use it beginning Fall 2000.

Although originally developed to solve the problems associated with collecting assignment materials for a large computer-programming course, it has been designed as a general-purpose system and so can be used for courses in any topic and of any size. eSub also seems ideally suited to distance learning initiatives.

Mapping Collaborative Text and Audio Communication over the Internet

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Abstract: This paper presents an approach to extracting, organizing and browsing audio and text contents of Internet-based collaborative meetings. The idea of creating mappings of *temporal* and *contextual* neighborhoods between text and audio is introduced. The differences between the notion of neighborhood in audio and text are discussed, and a prototype called COMAP is described.

Introduction

The remarkable growth that the Internet has enjoyed over the past decade has brought to the desktop a range of technical facilities for remote collaboration. Although asynchronous communication via email is still the most common form of Internet-based interaction, new scenarios involving audio and other synchronous media, as well as connected tools such as web browsers, are becoming increasingly popular. The work described below assumes a scenario where two or more collaborators interact mainly through speech, and are able to access the web, retrieve content and share it. Numerous empirical studies have clearly shown that speech plays a critical role in the effectiveness of group work. The importance of shared workspaces for supporting collaborative work has also been widely accepted (Masoodian 96). Various systems have been designed to support shared workspace interaction using audio, often with options for recording the interaction. However, few systems provide support for relating audio recordings of a meeting to shared documents (Moran et al. 97). The aim of the research described below is to create a computer supported collaborative work system which allows: (i) recording of audio among remote users, (ii) creation of shared documents in meetings, (iii) automatic indexing of audio recordings based on the content of shared documents, and (iv) access to audio recordings of meetings through shared document content, and vice-versa.

Temporal and Contextual Neighborhoods

In existing systems (Moran et al. 97) the indices for accessing different parts of the recorded audio contents of meetings are generated by: (i) either using manually inserted timestamps in meeting documents, (ii) or by using a speech recognizer and lexical analyzer on audio recordings to create a tree of recognized keywords which point to the relevant parts of the audio. Both methods have major limitations. The former relies on manual entry of the timestamps, which is unfeasible when the number of meetings or generated documents is large. The latter uses the contents of the audio recordings but ignores the contents of the shared meeting documents. In order to overcome these limitations, a meeting support tool called COMAP (COntent MAPper) has been designed. COMAP allows meeting participants to divide the contents of a meeting document into *logical sections*. These sections are then automatically linked by the system to different *segments* of the audio recording using the concept of *neighborhood*. COMAP defines two types of neighborhood: (i) *temporal neighborhood*: a segment of audio is in the temporal neighborhood of a document section if that audio segment was recorded while the section was being *created*, *changed*, or *discussed* by the participants, and (ii) *contextual neighborhood*: an audio segment is in the contextual neighborhood of a document section when it shares a number of keywords with that section. There can be multiple audio segments in the temporal neighborhood of a document section, each corresponding to different points in time when that section was *active* (Fig. 1).

There are essentially two usage scenarios for COMAP: the system may act as a *listener* while the participants interact through the tools provided by COMAP, or the system may act as an *assistant* for browsing the meeting document along with the audio communication. Currently, COMAP assumes that the shared meeting documents will be textual (minutes of the meeting or more elaborate documents produced, changed or discussed during the meeting). Since the text produced as a result of a meeting represents a more structured record of the information exchanged during the meeting, text is the starting point for the content indexing and browsing tools.

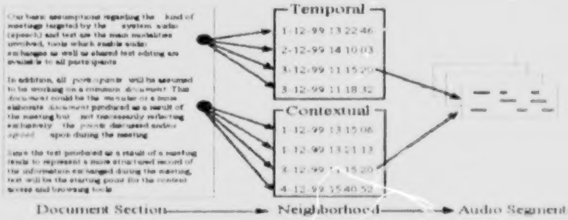

Figure 1: Neighborhood Mapping

Accessing contents is easier in written text than in recordings of spoken language. This is largely due to the fact that, unlike written language, which is permanent and parallel, spoken language is transient and serial. Audio browsing, has traditionally relied upon tools that employ a tape recorder metaphor: the user goes through the content sequentially, skipping over parts presumed to be less important by fast-forwarding and rewinding. Attempts have been made at providing a more structured presentation of audio contents of meetings. In (Luz & Roy 99), visual feedback on the participants' speech turns is displayed through a "musical score" interface. In meeting scenarios such as the one described above, the issue arises of how to "salvage" (Moran et al. 97) the discussion process which gave rise to a certain section by indexing textual contents to speech recordings. COMAP supports this process by mapping the textual sections of a document to their temporal and contextual audio neighborhoods.

Mapping temporal neighborhoods can be achieved by timestamping the manipulation of audio and text. After the meeting, while browsing through the meeting document, the user will be able to select a section and retrieve a stack of audio segments associated with it. In order to identify text sections and audio segments the system needs to be able to define neighborhoods for each media. Neighborhoods in text can be determined via syntactic, punctuation and formatting cues. Neighborhoods in speech are harder to handle. Currently COMAP assumes that each audio segment corresponding to a text section will contain the interval delimited by the first and last continuous textual timestamps for that section up to the first detectable silence. Mapping contextual neighborhoods requires a more sophisticated handling. The problem involved in this task is that, first, each section of the text needs to be processed so that a set of keywords can be identified. Once this has been done, the audio recording of the meeting must be scanned for these keywords. Finally, the audio needs to be segmented according to frequency and time of occurrence of keywords and linked to the text. All these tasks can be automated with speech recognition and information extraction technology. The Internet infrastructure underlying COMAP's functionality is the IP Multicast Real Time Protocol (RTP). RTP provides the timestamps needed for mapping the temporal neighborhoods.

Conclusions

This paper described the concept of temporal and contextual neighborhoods, which offers an effective way of mapping the contents of shared meeting documents to audio communication carried out between remote meeting participants during the processes of creation, discussion, or augmentation. Although the mapping functionality described above is still to be fully implemented, preliminary experimentation has been encouraging.

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EFFECTIVENESS OF ONLINE FEEDBACK: STUDENT TEACHER INTERACTION IN COMPUTER MEDIATED COMMUNICATION

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Abstract: This paper reports the findings of a study conducted on a graduate level course taught at a distance using the medium of an electronic conference. The conceptual framework for the present study is focused on an examination of the IRE (Initiate, Respond, and Evaluate) rule within electronic conferences. According to this rule, when information is exchanged, it gives rise to the three-move exchange structure: Question - Answer - Acknowledgement (followup/feedback). The study subscribes to the constructivist view of feedback as information that helps the learner construct his or her internal reality through social negotiation with peers. Discourse analysis techniques were used to examine the resulting transcript of discussion texts to explore whether the teacher's choice of follow-up move affects the amount and quality of student participation in discussion. Findings indicate that when teachers request justifications, connections or counter-arguments instead of providing feedback, they can develop a more equal dialog and effective online dialog.

Introduction

Computer-mediated communication has brought with it some unique modes of communication between learners and teachers. The need to receive feedback is important in traditional learning, but it becomes even more important in an online classroom where social and visual cues are absent. Within this new dialogic learning dynamic, feedback is perceived as information that helps the learner construct internal reality. It may be received through social negotiation with peers, or occur through comparisons of internally constructed knowledge. Here the perception of feedback moves away from the behaviorist views feedback as reinforcement that is used to correct and direct performance.

The conceptual framework for the present study is focused on an examination of the IRE (Initiate, Respond, and Evaluate) rule (Mehan, 1979). According to this rule, when information is exchanged, it gives rise to the three-move exchange structure or triadic dialogic structure: Question - Answer - Acknowledgement (Halliday, 1984). The third move was initially called 'feedback', and then changed to 'follow-up' (Nassaji & Wells, 1997). The teacher can change the third move and use a wider range of options such as 'accept' (including reject), 'evaluate' and 'comment'. Comments can be expanded to include sub-categories such as 'exemplify', 'expand' and 'justify.' Nassaji and Wells (1997) determined that the teacher's choice of follow-up move affects the amount and quality of student participation in discussion. They suggest that teachers can develop a more equal dialog by avoiding evaluation in the third move and requesting justifications, connections or counter-arguments. The intent of this study is to examine whether a similar dynamic is evident within the framework of online discussions.

The Study

Data was collected from a graduate course titled "Distance education: gender and Ethnicity" taught at a large Southwestern university using a computer conferencing system and a supporting web page. The course consisted of both face-to-face as well as online sessions. Students completed 9 written assignments, which included the midterm examination, research paper and the class presentation of that paper. Apart from this, students were required to participate in six discussion forums that related to assigned readings pertaining to the course. The study involved the collection of four different types of qualitative data: field notes, interview transcripts, discussion transcripts and other incidental data.

This study examines classroom discourse within the context of an online dialogic learning space and attempts to explore how basic discourse genres are enacted. The study used a variety of qualitative methods to achieve this purpose. Miles and Huberman (1994) point out that no study conforms to a rigid methods, since qualitative research is more of a craft than a given set of rules. Discussion transcripts and feedback messages were coded using NUD*IST research software with an aim to develop concepts that were eventually linked to form a theory.

Discussion transcripts were coded for discourse moves: Initiate, Response and Followup. Each of these categories were in turn coded for their sub categories. Initiating questions should be further classified as Known Information Questions (KIQs) and Negotiatory Questions (NQs). Followup moves were also coded for function and sub categories were generated for them as well.

Findings

The findings revealed that discussion threads that began with Negotiatory Questions did indeed generate a greater amount of dialog. For example one discussion thread that began with NQs resulted in 118 messages whereas one that began mostly with KIQs resulted in only 61 messages. Sequences that began with NQs tended to elicit responses from all students and resulted in a greater enumeration of responses into further sub threads. This trend was not evident in sequences that began with KIQs. When the teacher asked more questions and provided follow-ups of other kinds, such as asking for clarifications, explanations, or alternative opinions, or by offering comments or meta-comments of her own, she elicited a large number of responses. By providing these alternative responses, she avoided presenting evaluative comments on students' responses. This allowed the conversation to flourish. Earlier in the course, the teacher was given to contributing a greater number of evaluative responses to discussions resulting in a lesser amount of discussion responses. Whenever an evaluative move was included in a followup conversation move, it tended to end the thread of discussion. However, unlike face-to-face learning, this evaluative move can be provided by anybody other than the teacher.

Unlike face-to-face discussions, cyber communication is still a form of writing; the essential difference it has brought about is concerned with the pace of communication. The delayed format of asynchronous communication empowers teachers in yet another way. In spoken discourse, teachers do not have the time to consider the implications of discourse options available to them and it is usually done below the conscious level of attention in the general direction of the goal of the classroom activity. However, online instruction allows the teacher flexibility to make conscious decisions and strategic moves in a manner appropriate to the discourse genre that is aligned with the teacher's epistemological position and teaching philosophy.

A discourse genre consists of certain elements, which are obligatory and fixed in order. Other elements may be optional, and some others may be recursive. The micro genre associated with providing online consists of certain elements as well: motivation, guidance, validation, and supportiveness. These elements have sub classifications as well which were identified as part of the study.

Conclusions

Even when teachers try to create a dialogic environment for learning in their classrooms, triadic dialog seems to be a dominant discourse genre employed in online discussions. Negotiatory questions are more effective in producing an equal dialog than knowledge information questions. Also, evaluative moves tended to end the given thread of discussion. The Internet has become a revolutionary force because it has fundamentally shaken the very foundations of traditional learning. The main advantage of online learning is that if it is used to promote dialogic learning communities, it has the potential to even out the power differential in the learning environment thereby empowering the student.

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Application and platform independent storage of organisational data. Techniques, issues and concerns of secure, central data administration via the WWW

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Abstract: This paper discusses research currently being undertaken in the area of remotely administering organisational data via the WWW. This research project has both a theoretical and a practical component and is being conducted at the University of Western Sydney, Australia as part of an Honours degree in Business Computing & Information Management. Covered in this paper is the framework and scope of this project along with an outline of the various issues involved in implementing a practical LDAP based system.

Introduction

The theoretical part of this research project revolves around the issues in implementing a central data repository for enterprise information. This includes decisions relating to the size of the expected repository and its annual percentage growth estimation to developing best practices for data format and the criteria for data storage and sharing. In addition, this project critically examines the current trends in data administration in both management and policy development.

In making decisions about what data should be stored into the centralised repository and who should have access to it, issues like data ownership, accessibility and integrity have to be considered and measured against the benefits of moving to a centralised model. Associated issues being the setting of security permissions and security policies in the access of data. It is evident that there should be a mechanism in place to allow high granularity in setting access permissions to the centralised set of data. Securing the data using a granular access control mechanism being of high significance as changes in the repository will unavoidably have a ripple effect across the corporate applications and associated users.

The theoretical part of this research project covers the development of a methodology and a set of criteria for evaluating the feasibility of a centralised data storage solution. The methodology and criteria taking into account the nature of the data and the sensitivity of that data as well as the value it has in the context of the organisation that owns it. However, it is proposed that by having a pre-defined set of criteria will assure that factors like security, data integrity, ease of administration and scalability of the solution will not be overlooked.

Accompany the theoretical work in the area of storing and remotely accessing and administering organisational information, the practical aspect of this research project focuses on particular technologies that can be used to make such a solution viable at an enterprise-wise level. Specifically being developed is a client-server model for storing, retrieving and manipulating the information while taking advantage of the world wide web (WWW) as the platform for developing the communication interfaces between the users and administrators with the data server.

In particular, the Lightweight Directory Access Protocol (LDAP) running over TCP/IP, has been selected as the main server technology. There are multiple reasons for choosing this technology over other similar ones, some of these being:

- The technology allows co-existence and co-operation between other LDAP and X500 servers thus making legacy data still easily accessible.
- The protocol provides for very quick retrieval of the information and it can achieve the required results with significantly less hardware requirements compared to a traditional relational database system.
- Within LDAP, data is stored in the form of an object hierarchy thus providing a lot of flexibility for later refining the data needs of the organisation and adding or removing data elements from the existing repository.
- The protocol is supported by major companies in the IT world like Netscape (who co-developed it along with the University of Michigan), IBM, Microsoft and others. This means that continues support and development effort is likely to exist for quite a while still so that solutions built with this technology will not be lagging behind other solutions due to lack of improvements and on-going support.
- There is an open source movement already underway developing a suite of applications and APIs that fully support LDAP, therefore, by having free, unrestricted access to the source code of this implementation it will be easier to make observations about the protocol's efficiency, level of security, scalability and robustness.
- This protocol is supported in both Windows and Unix platforms therefore making a comparative study between the implementations on each platform possible. Also, availability of the protocol in both platforms makes this solution platform independent as an equally appealing choice between the two platforms is offered when it comes to implementing an LDAP based solution.
- Version three of the protocol has been granted an RFC status by the Internet Engineering Task Force (IETF) who is also currently working on new standard extensions for it. This therefore, guarantees that by using LDAP an organisation will not lock itself into a vendor's proprietary technology as the protocol has already been recognised as a worldwide standard.
- Inherently, LDAP offers granular access control to the data it stores which makes it appropriate for use within the environment of the University of Western Sydney, as there is a strong need for selectively providing different levels of access to the information to different users and groups of users.

In addition to setting up the centralised repository, the practical component of this research project involves the development of a series of clients that will interface to the LDAP server so as to retrieve information for the users and allow administrators to change or update that information as needed.

Following the same philosophy of platform independence, the clients will be developed as web based applications written in Active Server Pages (ASP) and either PHP or Perl (respectively). This will allow both users and administrators alike to access the repository of data remotely from wherever they are as long as they can have access to a web browser connected onto the internet.

The main reason for choosing to implement the client web application in two different server side scripting languages is so that the a better understanding of the working of the protocol can be gained, also there is a way of comparing the advantages and limitation of each of the client interfaces in terms of security and efficiency. Finally of course, the total solution for storing, accessing and administering the information centrally can be fully platform independent as both the server and the web based user interfaces are not restricted to a particular platform.

A practical component of this research project will be an LDAP based system for the University of Western Sydney where information will be retrieved, modified, deleted and added remotely via the use of web based applications running at either a Unix or a Windows based server. Initially for research purposes the data repository will be populated with contact details and location of staff at the university however at a later stage this information will be expanded to user passwords served via a connection secured by TLS or other secure transmission protocol. A further extension will be the replication of data between LDAP servers (possibly across different platforms) across campuses via the university's Wide Area Network (WAN). Currently, the process of LDAP inter server communication and data replication is not yet standardised although there are a few solutions already implemented but they only reflect a particular vendor's implementation of this facility.

In conclusion, this research project aims at providing more insight in the procedures that have to be followed, the problems that must be resolved and the technologies that can possibly be used to allow an organisation of medium to large size to better store and make its important information readily available in a centralised fashion. Thus, making it possible for users to access and administrators to maintain and add to this data remotely, while at the same time a sufficient level of accessibility, user-friendliness, performance, data integrity and security is maintained.

Web-Based Training in Addition to Conventional Education in Medicine

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Abstract: The development of internet-based multimedia courseware has become very important. Web technologies support smarter learning and make it possible to better manage changes, continually improve learning, and to offer an efficient representation of contents. The focus will move on from conventional teacher based lectures to learning centers. The challenge is not only for academic staff to change their work habits, but also for students to accept a changing concept of university education. In addition to passively receiving information in the classroom, students are invited to actively explore the medical knowledge in a Virtual Learning Center designed for flexible information linking.

Introduction

The commercial use of the World Wide Web causes an extensive change in information technology. Lifelong learning and adaptation of medical practice to new knowledge and new techniques will become even more important in the future. Through the integration of the Web-based course modules in learning environments the typical classroom is no longer bound by four walls. The development of WWW learning environments demands cooperative working teams of authors, who are able to master several areas of medical knowledge as well as the presentation of these using different multimedia facilities in Education Networks that focus on learning, not teaching.

Discussion

Internet-based multimedia courseware, e.g. the interactive use of Web-based course modules contained in a Virtual Learning Center, can be a valuable addition to traditional classroom courses. It is a challenge for the academic staff as well as for students to accept this in a changing concept of university education. The Virtual Learning Center at the Hannover Medical School is integrated into the campus network (Fast Ethernet) and consists of a Web server with a Library of Medical Lectures (Hypertext, PDF, ...) and a video server using streaming technologies. A multilingual Medical Image Reference Center (MEDIREC, Matthies, 1999) containing clinical and pathological images (still and moving) of neurological and neuromuscular diseases and typical, rare and difficult to diagnose cases is also available.

MEDIREC is a sub-project of the G8 Global Healthcare Applications Project to support clinical activities, contribute to medical education and training, and facilitate medical research. An editorial board is responsible for the quality assurance of contents. Efficient Web-based database access to the MEDIREC at the Hannover Medical School is made possible via an Oracle Application Server that uses Java-based programs to answer requests. The search masks and appropriate search results can be displayed in several languages.

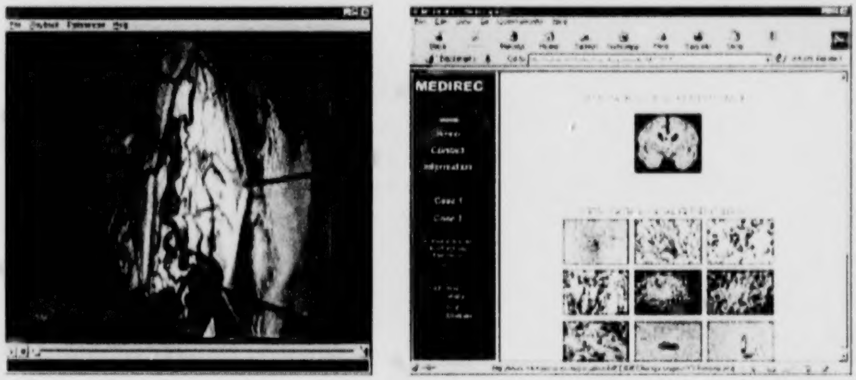

Figure 1: : Intraoperative photograph of a cervical spinal cord angioma (left) and case example of the multilingual MEDIREC (right).

The continued improvements of both network bandwidth and compression algorithms permit it to seamlessly integrate videos with other information and to distribute the result using the Web. The new Synchronized Multimedia Integration Language SMIL (1999) allows multimedia content, including text, images, animations, audio, and video to be synchronized for a coherent learning environment. The emergence of video on the Web forces hypermedia designers to solve the problems of integrating dynamic information types (audio and video) in Web-based course modules using the latest streaming technologies for high quality education, i.e. in neurosurgery and neuropathology.

How can lifelong learners be successfully supported in the 21st century?

- Create Web-based learning environments with focus on learning, not teaching
- Use interactive Web-based courseware in a Virtual Learning Center
- Use online library resources
- Support interactive case based databases

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Developing Distance Education Programs and Instruction: Peaks and Pitfalls

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Abstract: Distance Education is at the leading edge of technology planning and implementation, pedagogy, and instructional design methodology. Online learning provides opportunities for students with busy schedules, opens higher education to underserved populations, and creates a teaching/learning environment many feel is as good, if not better than traditional classroom instruction. The success of distance education programs and instruction is dependent on a number of critical factors: Leadership, Faculty Commitment, Institutional Commitment, and systematic Instructional Design and Development.

Introduction

Distance Education is at the leading edge of technology planning and implementation, pedagogy, and instructional design methodology. Online learning provides opportunities for students with busy schedules, opens higher education to underserved populations, and creates a teaching/learning environment many feel is as good, if not better than traditional classroom instruction.

Critical Factors

The success of distance education programs and instruction is dependent on a number of critical factors.

Leadership: An institution-wide leader must be appointed. This individual should have not only the content and organizational knowledge and skills to complete the project, but also the power to get things done (Shore, 1997). A committee representing areas such as academic departments, student services, library, and academic and administrative computer services should be appointed to oversee the project.

Faculty Commitment: Development of curriculum and methods to be used in the delivery of distance education courses and programs requires specific skill sets that may be possessed by a small number of faculty and staff. If we are to expand the scope of developers to include those with less computer knowledge, it will be necessary for them to either acquire these skills or to collaborate with the technologists. (Cummings, 1997)

Partnering with professional distance education providers, such as eCollege.com or others, can provide the expertise necessary for a small on-site group to successfully implement a distance education plan.

Institutional Commitment: The development of distance education instruction must be systematic and purposeful. Institutional strategic plans should be revised and updated to include distance education within all appropriate areas. The most critical factor is the matching of the program goals and objectives with the method of delivery to provide a highly progressive and relevant learning environment.

Admissions, Financial Aid, Advising, Library and Registration departments must be assessed in light of serving distance education students. Each department should insure the lack of physical proximity does not adversely affect services for distant students.

Distance education programs may be subjected to the regular University governance and review process. The Committee, with support from the President and administration, should assume primary responsibility for distance education at the institution and ensure both rigor and quality of instruction.

Instructional Design and Development: The critical element for success in any teaching/learning environment is the effectiveness of the instruction. To maximize the learning opportunities in a Web-based environment requires a shift in pedagogy. The essence of this shift focuses on instruction within the constructivist paradigm. Rather than designing instruction intended to deliver information to the learner, it is necessary to design instruction to engage the learner in interactive activities. Careful planning is required to establish learning as a process in which the student actively participates.

Although many models for course development are available, the major components are universal. The ADDIE model from eCollege.com includes the elements of Analysis, Design, Development, Implementation, and Evaluation. (eCollege.com, 1998)

Analysis requires an institution to conduct an initial needs analysis. The goal of this analysis should be to determine student needs and the Committee must decide if existing, modified, or newly developed courses and programs are more appropriate.

Design should include input from content experts, instructional designers, end users, program administrators, and university administrators. The design team must create the specifications for instruction to be effectively delivered through online computer capabilities to satisfy the needs discovered in the analysis phase.

Development is a collaborative effort between the content area expert and the technologist. The end product must meet the specifications, both technical and instructional, determined during the design phase.

Implementation is the litmus test for any online lesson, course, or program. Students are introduced to a learning environment created by the development team to meet the specifications of the design team that satisfy the needs discovered in the analysis phase. Unfortunately, many institutions do not progress beyond this point.

Evaluation is the determination if the process has been successful. Have the needs of the students been met? Have the learning goals and objectives been achieved? The data from this evaluation of student, content, instructor, time management, infrastructure, etc. must now be analyzed and the process begins again.

Conclusion

Although it seems certain Distance Education has found an appropriate niche in higher education, there are no guarantees of success. To have a chance, an institution must appoint a project leader, make a commitment and systematically plan to implement this new form of instruction, and ensure faculty are committed to the additional time and effort required for the success of these initiatives. Instructional effectiveness is the essence of online learning environments. This effectiveness is contingent upon innovative, appropriate instructional design and development.

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Automatic Exercise Generator with Tagged Documents Considering Learner's Performance

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Many Internet technologies enable us to hold lectures with Web contents and even develop new lecture methods using the technologies. This paper presents AEGIS(Automatic Exercise Generator based on the Intelligence of Students) that generates exercises of various levels according to each student's achievement level, marks his/her answers and returns the marked results to him/her. In order to realize this feedback mechanism, we currently restrict the three question-types, which can be generated from the same tagged document. The aim of this system is to help the students understand the lecture.

Introduction

As the Internet has come into wide use, WWW environments provide lots of opportunities to various fields. In the educational domain, Web data are being exploited as useful materials. This paper presents AEGIS(Automatic Exercise Generator based on the Intelligence of Students) that generates exercises of various levels according to each student's achievement level, marks his/her answers and returns them to him/her. A lot of quiz generators on the Web have been proposed so far. Unlike AEGIS, however, most of them restrict only some specific question type such as a multiple-choice quiz and do not describe any effect of making the difficulty level of question-type change according to the students' achievement level. In order to improve their performance and keep their enthusiasm to challenge the quiz for a long time, it is indispensable to consider their performance in generating their exercise. AEGIS provides the facility that selects an appropriate question and its type as considering students' achievement level, which is calculated with their trial histories to the questions.

Automatic Exercise Generating

Since our aim is to get a computer generate an exercise and mark the student's answer to it, we thus currently restrict its question-type to the following three types: multiple-choice question, fill-the-gap question, and error-correcting question. All of them can be constructed from a same sentence by replacing one or more consecutive words with a blank or a wrong expression. We call the replaced region *hidden region*. These three question-types have different difficulties even if they are constructed from the same *hidden region*. The exercise generating process from teaching documents consists of the following three steps: (1) Setting a *hidden region*, (2) Selecting a paragraph or sentence(s) before and after the *hidden region* as *question region*, which may have more than one *hidden regions*, to ask the unique answer of the question, and (3) Constructing a candidate list. Since these steps are deeply related to the teachers' intentions, we define the three tags: **QUESTION**, **DEL** and **LABEL** to specify their intentions in the documents. **QUESTION** surrounds a question region and has an attribute **SUBJECT** to specify the subject or topic of the question region. **DEL** indicates a *hidden region*. All we have to do for making some fill-the-gap questions is to replace the *hidden region* with a blank. **DEL** has an attribute **CAND** which is used to embed a candidate list directly into the **DEL** tag. **LABEL** has an attribute **NAME** that specifies the dependency relations with *hidden regions*. **LEVEL**, **GROUP and REF** are defined as the additional attributes of **DEL** to generate an exercise that is suitable for the achievement level of each student.

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AEGIS system

The AEGIS system consists of three databases and three main database managers as shown in Fig. 1. Teaching documents with the tags are compiled into the *Exercise DB* and *Level Management DB*(**LMDB** in short). All of the question regions are indexed sequentially and each *hidden region* is labeled with its own subindex of the index of each question region. The level of a *hidden region* is stored in the LMDB together with the index of the *hidden region*. *User Profile DB*(**UPDB** in short) keeps students' personal trial histories with their current achievement level. *Exercise Generator* and *Answer Evaluator* make communications with the users (students) through Web browsers after being invoked through CGI (Common Gateway Interface). **AEGIS** system determines whether or not the *hidden region* is worth being transformed into the exercise by examining the student's UPDB and LMDB. *Level Manager* increases the difficulty level of a question if a student whose level is greater than the question's level, answers it wrongly and decreases if a student whose level is less than the question's level, answers it correctly. After updating LMDB, *Level Manager* updates the student's level according to the levels of all questions s/he correctly answered. Now, let $s_{i,t}$ and $q_{j,t}$ be the achievement level of student S_i and the difficulty level of question Q_j at time t respectively, $1 \le s_{i,t} \le 10$,$1 \le q_{j,t} \le 10$. $s_{i,t}$ is recursively calculated with $q_{j,t}$ at stated periods and vice versa. They are defined as follows:

$$s_{i,t} = \begin{cases} 1 & \text{if } m_{s_i,t} = 0 \\ \frac{1}{m_{s_i,t}} \sum_{j=1}^{m_{s_i,t}} q_{j,t} \cdot \delta_{i,j} & \text{otherwise} \end{cases} \qquad \delta_{i,j} = \begin{cases} 1 & \text{if } S_i \text{ answered } Q_j \text{ correctly} \\ 0 & \text{otherwise} \end{cases}$$

Where $m_{s_i,t}$ denotes the number of questions that S_i tried by t.

$$q_{j,t} = \begin{cases} q_{j,t-1} + \dfrac{\sum_{i=1}^{m_{q_j,T}} |s_{i,\tau} - q_{j,t-1}| \, \xi_{i,j}}{\sum_{i=1}^{m_{q_j,T}} |\xi_{i,j}|} & \text{if } \sum_{i=1}^{m_{q_j,T}} |\xi_{i,j}| \neq 0 \\ q_{j,t-1} & \text{otherwise} \end{cases}$$

Where $\xi_{i,j}$ is the function that returns -1 if $s_{i,\tau}$ is less than $q_{j,t-1}$ and S_i answered Q_j correctly, 1 if $s_{i,\tau}$ is greater than $q_{j,t-1}$ and S_i answered Q_j wrongly, and 0 otherwise. τ is the latest time such that S_i tried to answer Q_j and $t-1 < \tau \le t$. T is the set of τ. $m_{q_j,T}$ denotes the total number of students who tried Q_j in T. $q_{j,0}$, which is the initial difficulty level of the question Q_j, is given with the attribute *LEVEL* of *DEL* tag by teachers.

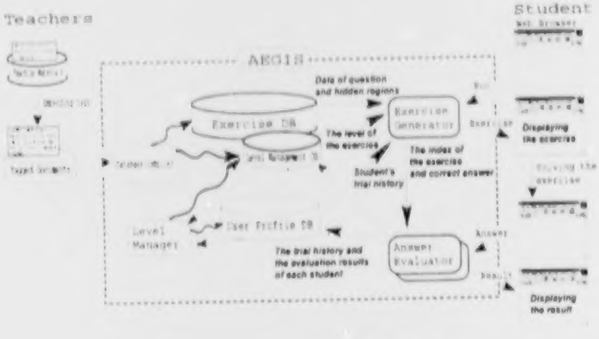
Teachers
Student
Web Browser
AEGIS
Data of question and hidden regions
Exercise DB
Exercise Generator
The level of the exercise
Student's trial history
The index of the exercise and correct answer
Exercise
Displaying the exercise
Trying the exercise
Tagged Documents
Level Manager
User Profile DB
The trial history and the evaluation results of each student
Answer Evaluator
Answer
Result
Displaying the result

Figure 1: Overview of AEGIS

Conclusions

We discussed our new Web-aided system AEGIS and presented the method to calculate both the achievement level of a student and the difficulty level of a question according to students' trial histories. The system is currently implemented in Perl scripts and CGI. It is expected to work fine as an educational tool for every student and helps him/her to understand every subject if teachers can make tags in their teaching documents. We will evaluate this system by applying it to the real courses of Computer Literacy, which are taken by more than 2300 students at our university.

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Project Management over the Internet

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Abstract: One of the many benefits of the Internet includes the ability of researchers to communicate with other researchers in different parts of the World. Lately a new concept has evolved that utilizes the power of the Internet, that of software engineering over the Internet, where developers of a software system may be located in different physical locations, yet, cooperating together through the Internet to accomplish the end result system. As successful project management is necessary for the successful completion of any software project, it is important to develop methods and tools for the management of such projects being developed over the Internet.

Introduction

This paper presents an ongoing research to develop a project management system over the Internet. The purpose of this system is to provide the project manager with the necessary tools for the easy scheduling of project activities and hence after, the ability to track and monitor the progress of project activities throughout the life of the project. Project members spread-out across the globe, will be able to view the project schedule and communicate easily with their peers and project manager about their progress and any problems that relate to the project schedule.

System Goals and Benefits

The Internet Project Management System (IPMS) is a graphical Web based project management set of tools. It is expected to perform as a fully functioning project management tool such as Microsoft Project.

Using IPMS would be through a special Web Site that allows a project manager to establish a new project management account on the Site's server. The new account will be established as a new subdirectory of the IPMS Web Site, which can be accessed though its own URL. The manager may limit access to the created account through the establishment of different user accounts that are password protected. One of the accounts is the manager's own account which allows restricted access for the creation and manipulation of project activities and schedule data. Another account along with its own password can be created and distributed to project members. The later type of account is limited to viewing and writing of comments only, no update functionality shall be granted. Only the project manager who established the main project account may have update rights.

Input of project data such as activity names, duration, starting date, ending date, etc. can all be entered through the project account's Web page using tabular input fields. The type and number of fields to display to the manager for input will be dynamically generated depending on the type of specific chart or operation requested. The main operations and charts that a manager may benefit from as a result of using IPMS include:

- Gantt Chart,
- Critical Path Method (CPM) network,
- Probabilistic Evaluation and Review Technique (PERT),
- Resource Leveling, and,
- Cost Analysis.

Resulting output from any of the above tools will be dynamically generated upon request in an easy to understand graphical format. A sample example is the highlighting of already completed activity nodes based on starting project and activity dates, or, on actual completion of some project activities when such indications are set by the project manager.

One of the expected benefits of this system is its ability to save and maintain older versions of project schedules. This enables the project manager to compare the initial project planned schedule against any updates to the schedule. The main benefit of this system is in being a platform independent set of tools that can be easily used by any person with access to the Internet. No special tools need to be purchased to perform project management operations.

Conclusion

Internet Project Management System is a Web-based tool, still under development, that enables the creation and manipulation of project scheduling and activity data. It is a platform independent tool that can generates project management charts and networks with ease and whose results can be viewed immediately by project members no matter what their location in the globe may be.

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Corporate Knowledge Hubs Become a Basic Business Element

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Abstract: Organizations and individuals are becoming more reliant on the web for information and education. One stop online information and education communities have arisen from the convenience of web-based training applications combined with a large number of users with specific information and training requirements. Strong demand for sites featuring topic-related knowledge and education has led to the creation of a new series of information providing web elements. These new elements include portals, hubs, and knowledge hubs.

This paper will examine factors that led to the development and deployment of these web-based elements. It will also provide definitions for these new knowledge and learning elements, and explore unique characteristics and applications of portals, hubs, and knowledge hubs.

Evolution of Web-Based Information and Training

The convergence of web-based training (WBT) and knowledge management into knowledge hubs is a natural evolution of technology striving to serve and meet organizational business needs. "A knowledge hub is a destination online where you can fulfill all of your knowledge needs" according to Howard Marks, CEO of Yipinet LLC (www.yipinet.com), a Web-based education company in California.

Corporate Example

An example of knowledge hub development occurred when the Harris Corporate organizational learning team strove to create a site that supports employees' need for training and information while maximizing return on investment with internet technology and training. Empowering employees with the elements and tools to become independent knowledge workers was also an objective of the Harris team. Preliminary research strongly indicated that the application of portals and knowledge hubs would play significantly in the overall organizational learning strategy. Gradually these portals and knowledge hubs would become a basic business element, used daily as a routine aspect of performing job duties.

Factors

An analysis of business factors and technical environment was performed in order to determine the best overall learning strategy for the organization. The strategy had to account for multiple training and information needs within a large geographically dispersed corporation in an economic manner.

Business factors identified were diverse training and information needs, and personnel distributed across several states and countries. Fiscal drivers included the desire to reduce travel and training costs while improving the skills and knowledge of employees. The technological factors taken under consideration included accelerated desktop computer processing speed, improved browser technology, and such features as Java enabled client server interactivity, improved backend database technologies, the ubiquitous availability of commercial internet service providers, and improved access to the bandwidth needed for large file transmission (Wagner, 1999).

After performing a comparative analysis of business and technical factors, the long-term strategy for Harris' online learning began to evolve into an overall corporate training and information site that could function as a portal to specific learning hubs for various job categories and engineering disciplines.

Requirements and Terms

Although the terms learning portal, learning hub, and knowledge hub are often used interchangeably, most experts assert that differences exist among the terms. Because terminology often drives requirements and scope of work, it is important to be aware of the differences between search engines, portals, and hubs.

Search Engine

A search engine is software that searches for data based on specific criteria (Fister, 2000). Search engines are used on the Internet and in any searching tool used in software. A very common search engine is the "find" feature in Microsoft Office applications.

Portal

According to Howard Marks, a portal is an entry point to the Internet. LookSmart.com, Yahoo.com and Lycos.com are all portals. Portals have search engines, but they also have links to information on a specific topic that contain value beyond the search feature. A portal can be a gateway to a knowledge hub. For example, at a portal for lawyers, one of the links might lead to a knowledge hub with college courses, training programs and legal resources.

Hub

According to (Fister, 2000) the word "hub" on its own means any destination on the Web that has a specific audience. For example, Amazon.com is a hub for shoppers, ZDNet.com is a hub for e-commerce, and gardening.com is a hub for gardeners. Hubs usually offer information and e-commerce resources.

Knowledge Hub

A knowledge hub is an Internet-based learning community designed for a specific audience (Fister, 2000). Users can find college or training courses, get access to technical experts, buy books or software, and read industry news. Knowledge hubs are also known as learning portals and knowledge portals.

Ongoing Endeavor

A corporate training and information site to be accessed by all Harris employees went online in August 2000. This corporate training and information site will serve as the portal to various knowledge portals for specific audiences throughout the company. It follows the strategic plan for continually increasing the breadth and depth of information and training offered via the corporate training portals and knowledge hubs.

Immediately upon the launch of the corporate portal, two unique knowledge hubs for legal counsel as well as system engineers were deployed. Further, both of the two new knowledge hubs already have additional items under development for future online deployment. Several other knowledge hubs, including Performance Support Engineering and Information Technology are currently under development and scheduled to go online next year.

Knowledge hubs and portals will continue to become basic corporate tools as technology advances and business factors address employee needs as specialized knowledge workers. Successful deployment of a knowledge hub depends upon accurately defining organizational business goals, creating a viable learning strategy and on having a clear understanding of requirements and terminology.

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Sharing Bookmarks among Same Interest Persons

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Abstract: We propose Bookmark-agent system that enables users to share information in each user's bookmarks with others. This system is more effective in finding specific information that is a common interest of all the members in a group than existing search engines, such as Yahoo and AltaVista. When a user wants to find certain URLs, the Bookmark-agent will find them on behalf of the user. In addition to that, the Bookmark agent requests other Bookmark agents to search their own bookmarks. As a result, the user can obtain information that best matches his/her needs from the Bookmark-agent. Since users filter the selected information beforehand, it is possible for the Bookmark-agent to satisfy a users' requests more precisely than existing search engines. After conducting experiments on six users, we have found that the Bookmark-agent system is a promising approach to share URLs in a small community.

1 Introduction

In this paper, we propose Bookmark-agent system. The agent, which represents each user, uses user's bookmarks to get he/her interest. The bookmark is URL as filtered information from all Web pages in the WWW. In a small user group having the same interest, the agents share bookmarks of each user as their interest through communication in between them. The group has been gathered beforehand. A Bookmark-agent assists a user to search for the sites that resemble a Web page visited. The agent refers user's bookmarks and others through communication in between them if users allowed the bookmarks to be open to public. There are no need to give any keywords to the agent, because the agent can extract some keywords from the Web page a user has just visited. Note that a Bookmark-agent gives its user a smaller number of more significant URLs than the result given by ordinary search engines, because the agents utilize bookmarks, which are filtered information of the WWW by users, and are only used in a small group sharing the same interest. Keywords that represent users' interest make the number of presenting URLs less than the result given by ordinary search engines.

Siteseer (Rucker & Polanco 1997) utilizes each user's bookmarks as an implicit declaration of the interest in the underlying content. The difference from Bookmark-agent is that Siteseer measures the degree of overlap in URLs between each user's folder and other people's folders. WebMate (Chen & Sycara 1998) learns user's interest incrementally and automatically sends mails that match user's interests. Moreover, it adds keywords from a user profile to search for URLs of interesting sites. WebMate monitors user's browser to get user's profile, while Bookmark-agent makes profile from bookmarks. Beehive (Huberman & Kaminsky 1996) designs a distributed system for social sharing and filtering of information on email system. Information of interest by a user is sent to members of listed groups through Beehive system. The member who does not communicate is deleted from the member list, if the frequency of his writing messages is lower than a threshold. Content of message is no concern of this system.

2 Bookmark-agent

An Bookmark-agent is invoked for each user and assists searching the WWW. Functions of Bookmark-agent are the followings:

- Extracting keywords from a new URL.
- Indicating URLs of similar pages[1].
  Searching for similar pages requires the following processes:
  - Searching the user's keyword-database.
  - communicating and requesting to other agents in order to search other users' keyword-databases.
- Accepting a search request.

We define a set of keywords for a Web page. Each page consists of words surrounded by tags, which weighs the words. We prepare a set of Keyword-weight pairs. The set has no duplication of the same keyword, and weights for the same word are added together. The top 5 keyword-weight pairs are selected to be used as the keyword set of the Web page. The following tags and weight assigned to each tags (in parenthesis) are used to calculate the weight for each keywords: `CONTENT` attribute in `<META>` tag (10), `<TITLE>` tag (10), `<H1>` tag (6), `<H2>` tag (5), `<H3>` tag (4), `<EM>` tag (1), `<U>` tag (1).

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[1] defined as a page whose similarity is over a threshold

The similarity between two Web pages is defined as the number of elements in the product set in between the keyword sets of these two Web pages. The similarity varies from 1 to 5.

3 Experiments

We calculate precisions when one to three keywords in the databases are given to an agent. We chose the keywords that are surely contained in the keyword-databases of all users.

For comparison with Bookmark-agent, the search engine Goo[2] is used, since Goo answers a lot of URLs and uses a Web robot for retrieval. Our assumption is that Goo's capability of answering a lot of URLs must have covered all area of ordinary interest. It is not easy for users to find necessary URLs out of many URLs search engines recommend. To solve this problem, some search engines present URLs in the order sorted by priority to a user. To evaluate precision from the proportion of the retrieved documents that is actually relevant, if the search engine answered 20 URLs or more, we decided to use the URLs from the top to the 20th.

For evaluating the performance of Bookmark-agent, we prepared six users as testees who had 782 bookmarks as a whole. These users used Bookmark-agent and had already their own keyword-database.

In these experiments, a user inputs keywords to Bookmark-agent or the search engine, Goo. The relevance of each URL presented was judged from his point of view.

4 Discussion on The Experimental Results

A keyword used in a group sharing concept is presented higher precision than one is not used in the group. For instance, 'agent' usually means that the person who takes user's place or give service for users who cannot do. However, it is clear that the 'agent' in the group of testees means agent system in AI. The precision of keyword 'agent' in the search engine Goo was half or less than average. However, the precision of 'agent' in Bookmark-agent did not change, regardless of the number of keywords. Therefore, it is reasonable to suppose that users have common sense regarding the keyword, and it is considered as that the users share preference.

The rank sum test between precision of each keyword from Bookmark-agent system and that from Goo was conducted for each case of Table 1 to 3. As a result, we found a difference between the result of Bookmark-agent and that of Goo on significance level of 5% in each test. Thus, the method of the search engine Goo did not have ability of that of Bookmark-agent.

First, we pay attention to the preference that is shared in the group. Although the user in the experiments does not share preference in general sciences, they have common sense in AI, robot and agent system. Which is the reason that the precision of 'ai', 'robot' and 'agent' are higher than that of 'science'. The keyword in which they share preference presents more URLs than the one in which they do not share.

Next, we pay attention to the preference that is not shared. The keywords 'robot' and 'linux', the query of which returned 10 and 22 URLs respectively, are the words which concepts are shared among the users. On the other hand, they do not share the concept of the word 'perl', because only the user C have preference on 'perl.' As a result, the keyword 'perl' returned only 3 URLs. Normally, a user must have been indicated more URLs to 'unix' than to 'linux'. The keyword 'linux', however, returned more URLs than 'unix', because the number of the users using Linux is more than that of using Unix.

5 Conclusion

We proposed Bookmark-agent, which uses bookmarks to support users' searching for information, and conducted experiments on six users. Sharing URLs of each user's bookmarks, which helps indicating necessary Web pages, Bookmark-agent provides a few but significant URL as a search result. Bookmark-agent is clearly different from general search engines on the point that search engines often give a large number of URLs that often contains irrelevant information to users. By using bookmarks, Bookmark-agent is able to provide a small number of URLs to a user who shares preference with other users.

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[2] `http://www.goo.ne.jp/`

Developing Learning Materials Efficiently for Web Access as Well as for Printing and for Projection in a Classroom

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Abstract: Presents a strategy for the development of learning materials that are suitable for access through the WWW, and that can also be used efficiently for the creation of printed study materials as well as for projection during meetings with the students in a classroom. Maintaining and developing one master saves time and avoids differences in various versions.

0 Introduction

This contribution focuses on a strategy for the development of learning materials that are suitable for access through the WWW, and that can also be used efficiently for the creation of printed study materials as well as for projection during meetings with students in a classroom. Instead of replacing more traditional learning materials with web based versions only, or instead of developing materials for the web *separately, besides* more traditional versions, only one master is created for each document. This master is created so that it can be made accessible easily through the web, that it can be directly used to print each document and that it can be applied for projection from a notebook pc. The courses for which this strategy is developed, tested and applied are organised at the Vrije Universiteit Brussel and at the University of Antwerp, in Belgium.

1 Methods Developed and Tested to Create Learning Materials

The software packages applied are common, well known, cheap and well updated, at least in comparison with most of the more dedicated programs to create and maintain a learning environment.
The following computer programs and file formats are used:

- To manage the Web site: Microsoft FrontPage.
- To create slide presentations: Microsoft PowerPoint, saving each presentation as a show (PPS files, the master files) from which a version for the web is derived in HTML / XML.
- To create and maintain other documents than presentations: Microsoft Word, saving most files in Rich Text Format or in HTML / XML format for the following reasons. On most pc's a program is available to view the document in this file format (which is not the case with proprietary formats such as the Word DOC version 95 or 97/2000 formats). The formats allow printing accurately (which is not the case with classical HTML documents). This works without the need for an additional, extra master version plus conversion after each modification (which is not the case for instance with Adobe PDF).

Most work has been done with at least two of the previous versions and with the present version 2000 of these programs.
Many of the created documents contain links to web-based sources, and as all files are incorporated in one 'web', FrontPage can be used efficiently to check those links together with all the other links in the 'web', and to reveal other possible deficiencies.
Problems met in the transition to newer versions of Microsoft Office include the following:

- The conversion of FrontPage 98 to 2000 forced us to convert the web from mixed case to lowercase only, as we use Unix servers that are case sensitive.
- The conversion of PowerPoint version 95 files to version 97 files caused an inversion of many arrows in the images on the slides.

- The conversion of PowerPoint 97 to 2000 caused two colors to be taken from the existing color schemes for unvisited and visited hyperlinks. Consequently, colors indicating links were not suitable, but changing these colors caused unwanted changes in other parts also.
- Saving Word and PowerPoint files in HTML format (including XML) has become more powerful but also more complicated, so that the help provided by the software package was not sufficient anymore to understand the process and to make reasonable decisions.

On the positive side, the 2000-versions of the programs are better now for application in a web environment. For instance:

- Files saved as web pages keep most of the information that is present in the richer proprietary Microsoft file formats, by using XML in the files.
- Slides containing PowerPoint animations could not be converted with version 97 to HTML plus images for access through the web, but version 2000 can accomplish this; even animated slide transitions can be converted to HTML.
- Animated GIF files were displayed with PowerPoint 97 as static images only, but version 2000 displays the animations.
- The URL's mentioned in the slides can easily be made into hyperlinks that can really be used directly in the web, like in any other HTML web page.
- The slides are resizable, not fixed as the GIF or JPG images that can be created automatically from each slide by PowerPoint 97.
- A slide can cover the whole screen display, independent of the resolution of the user's display, which was not the case with PowerPoint 97, and which allows a much nicer display than a more common HTML page displayed by a web browser.
- Notes coming with a slide show can be shown if wanted, simultaneously, together with the corresponding slide.
- When PowerPoint 97 is used to save a presentation as web pages, a separate pure text version of the slides is created besides a version consisting of GIF or JPG images only. Version 2000 however can save a PowerPoint presentation file as a set of files using HTML with XML, so that text and images are 'married' together; one of the advantages is that the contents of the real slides can be indexed by search engines for later retrieval through the web, whereas with version 97 only the 'unused' text versions were indexed.

Some problems are still experienced with version 2000 of the programs. For instance, the presentations in the form of slides can only be offered as web pages with high quality and high fidelity, when one particular choice is made of the several options offered by PowerPoint 2000 to save as web pages; in that case, the resulting presentation can only be seen when Microsoft's own Internet Explorer version 4 or 5 is used, not by users of another browser like Netscape up to the recent version (4.6).

Communication with students is supported by standard Internet electronic mail. Everyone can choose a client program.

2 Learning Materials Created and Made Available

The topics are all related to information literacy, mainly focusing on applications of information technology and on information retrieval.

Documents that support learning include the following.

- For each course, one document presents an overview of the contents, the aims, and the evaluation procedure. This is made accessible through the web and is provided printed to each regular student taking the course.
- Series of slides (presentations) offer the course contents, including questions, tasks, problems, practical exercises for the students and links to external information. These are made available as a book and through the web as HTML with XML.
- One file makes a table of contents available for all the slides.
- An extensive bibliography is offered through the web about the subjects covered in the courses, structured in chapters.
- Web pages serve as container for those documents, and offer a few links to external information, but most of the links are included in an appropriate context in the documents mentioned above.

Up to now the starting page is http://www.vub.ac.be/BIBLIO/personal/nieuwenhuysen/courses/

Cooperating agents in a virtual laboratory for supporting learning in engineering and science

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Abstract:
This paper presents a system called Cyberscience[1] dedicated to distance education. The learning interface of Cyberscience includes a component consisting in activating an interactive multimedia simulation in which the student can carry out direct manipulation tasks making the simulation a virtual laboratory (vitual lab in short). A virtual lab for genetic study is currently realized (see [10]). As an intelligent distance learning system, Cyberscience includes a number of intelligent learning agents that operates in the space of the virtual lab in order to help students to achieve their goals. This paper presents an overview of those agents and how they act in the virtual lab.

Introduction

In the last few years, online courses had taken an important part in education and distance education. Many works have been done in this field and we can refer to WebCT [1], Blackboard [2], TopClass [3] and more. The learning environment in existing systems is characterised by:

- An user (student and teacher or course producer) interface;
- Courses importation and storage functions (most of the time in HTML format);
- Students files management system and
- Some utilities tools like chat room, forum.

These tools present a lack of multimedia manipulation and simulation area. They have no form of intelligence which could help to produce a dynamic courses based on the student or group needs, or to intelligently manage the learning session given the students current state of knowledge. To compensate those lacks, we are working on a similar project, which will not replace existing tools but will be like a complementary. The project is naming CyberScience. We are not trying to reinvent the wheel. We are trying to integrate CyberScience to an existing tool like WebCT in order to reuse must of its components. CyberScience is an Intelligent Tutorial System for distance education. It provides learning activities based on simulation and direct manipulation and integrates a multimedia virtual laboratory. The work we are presenting here is a part of CyberScience project. This project is funding by the University of Sherbrooke and aims to create a web-based ITS for distance education. We are actually aware about proliferation of virtual laboratories on the Web. This proliferation is cause by the lack of space, the real equipment cost, the experimentations time and more. Most of these virtual laboratories incorporate hard-coded intelligent behaviour in the system without a clear separation with other virtual lab components or functionalities. The consequence of this approach is the lack of flexibility of these intelligent behaviour and this lead to static virtual laboratory with a difficult-to-maintain intelligent behaviour integrated in. To solve this problem, we propose to transfer the intelligent behaviours involved in the virtual lab into intelligent learning agents and to introduce a dynamic communication layer between virtual laboratories and those intelligent agents.

There is already a lot that has been said about software agents, especially intelligent agents' technology. While this is really a current trend in software engineering. The concept of intelligent agents is at the same time simple in principle and complex in classification [4,5]. While intelligent agents systems are widely being developed, most of the frameworks available simplify the architectural and technical aspects and provide relatively no support to implement agent behavior. The goal of this research is to provide people with a strong basic architecture and shell to handle the complex task of implementing intelligent behavior in software agents. The tools provided must have a fairly generic aspect so they can be applied to a wide variety of problems and systems while still being able to adapt sufficiently to a problem to provide relevant intelligent features. It should be possible to achieve such capability by building a set of general-purpose agents that would be easily customizable and reusable.

After a brief presentation of an example virtual lab implemented in Cyberscience, an overview of learning agents involved in the system is presented.

Virtual laboratory in Cyberscience

Many works have been done in virtual laboratory in the past few years. We can see Rice's Virtual Lab in Statistics [6], Virtual Engineering/Science Laboratory [7], Virtual Laser Lab [8], Virolab[9] and more. Some of these laboratories use a simple Java applets, Java 3D and CORBA and others use Virtual Reality Modeling Language (VRML) and Shockwave. Most of them reproduce phenomenon observe by students in the corresponding discipline some reproduce real worth phenomenon and others allow to manipulate real machines over the Web or to simulate real laboratory experience in a virtual laboratory.

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[1] This project is funding by the University of Sherbrooke.

The CyberScience learning interface includes a course structure view, a working area (lesson learning, direct manipulation area for virtual laboratories and autoevaluation working area with quiz, exercises,...), a communication tool bar with functions such as video-conferencing, on-line supervision, discussion board and so on. It also includes intelligent learning agents such as Troublemaker, coach... The CyberScience learning interface is adaptive interface, which change dynamically according to the current settings. For instance, when the student choose a new course, some parts of learning interface change accordingly:

- A new course structure is built;
- The icons representing online human resources associated to the course are set-up;
- The learning mode is activated according to the default one defined in the course;
- The learning agents' board is initialised with authorised agent assigned to the course by the teacher or the instructional designer.

In CyberScience, we have built the first prototype of the virtual laboratory in biology especially in DNA digestion. DNA Virtual Lab uses a database containing information about a DNA to generate real laboratory experience by simulation on user request information. This prototype was developing with Java Language. When the user use the DNA Virtual Lab the first time, the system is able to detect him as new user and then show him a selection windows in which he can choose the form of the DNA (linear or circular) he will like to work with during the experimentation. Then, the user is asked to give information about the digestion and submits then to the system. The system then generates the digestion result form and allows the student to analyse and interact with the resulting data.

During the student manipulation, different agents observe the interaction in the virtual lab in order to intervene during the process. One of the main goal in Cyberscience is to create generic model for those agents and implement a way they can communicate with the virtual lab [10]. In the following, we present an overview of agents that cooperate in order to assist a user of the Cyberscience virtual lab.

A set of multiple agents

The first part of building such a set of agents is to determine a set of feature that are desirable and that are sufficiently high level to be reusable. The current proposal includes a planning agent, a decision making agent, a data mining agent, a rule-based reasoning agent, a data extracting agent and a case based reasoning agent. These agents cooperate in the context of CyberScience in order to: create an action plan for the current instructional objective associated with the selected course or theme, according to the student model, select the relevant resource the student will use to achieve the goal, update the student state of knowledge, help the student during the learning process and so on. In the following, we describe each of the agents.

Data Mining Agent

The Data miner has a high probability of being highly useful to many different applications. Basically, this agent's purpose is to retrieve useful information from databases and electronic documents both on a local machine, a network or even the Internet. Of course it can mean only search for certain keywords but it is also possible to implement more complex and advanced intelligent search algorithms. It remains to be decided how it is most convenient to interface with such an agent. It is also to be considered if such an agent should be mobile or not or even if it should decide whether it should move itself to a different host system to be able to accomplish it's job more efficiently.

Rule-Based Reasoning Agent

The rule-based reasoning agent acts mostly as an expert system. Expert systems have proven over time to be efficient to a large number of tasks. The goal of this agent is to derive conclusions from a knowledge base consisting of facts and knowledge. It needs an engine and a set of deductive rules. It needs an interface to specify the content of the knowledge base. An interface also needs to be defined to query the truth of undefined facts. The engine would be most likely based on the Rete algorithm that is already well known and extensively used and tested.

Case-Based Reasoning Agent

The case-based reasoning agent on the other hand compares the different cases and makes generalizations out of them. When the case-based reasoning agent is invoked on a particular situation it tries to find already known cases that are similar to the current one.

Planning Agent

The planning agent is software capable of making plans. The goal is to come up with a combination of actions to be executed in the future in order to achieve a desired behavior. The interface to the planner agent is a bit more complicated than previously discussed agents, but this is expected considering the complexity of planning problems. First it needs a way to specify an initial state and a goal specifying the desired task to be achieved. It also needs a set of specifications of the actions feasible by the system. Finally it needs a planning strategy, a starting plan and a set of bound parameters both in time and space. The agent's engine would be most likely to base on SIMPLAN because of its capacity to operate in highly variable environments. This agent will generate a plan of actions repairing the plan given in input that best satisfies the goal from the initial state, given the restrictions implied by the bound parameters.

Decision-Making Agent

The decision-making agent and the knowledge extraction agents are making extensive use of previously discussed agents in this paper. They would probably encapsulate specific instances of these. The decision-making agent, as its name implies, takes decisions about the different tasks to be done and how they must be accomplished effectively. It would work by using the rule-based agent to generate a goal as of what to do. A planning agent starts to search how to best achieve the goal by calculating a new plan while case based reasoning agent tries to find a relevant plan that was previously used in a similar situation.

Knowledge Extraction Agent

The knowledge extraction agent finds relevant information from different digital data sources. Like the decision-making agent, the knowledge extractor uses a combination of three internal agents. It obviously uses a Data Mining agent to retrieve pieces of documents or database information related to a subject requested by an internal rule-based reasoning agent. But a case-based reasoning agent also tries to find similar cases as where relevant was found to help the data mining agent. Once it is retrieve the information can then be used by the system.

Conclusion and future works

We have presented an intelligent distance learning system called CyberScience and the way this system allows the integration of complex virtual laboratories with intelligent learning agents. Up until now, one virtual lab is created and we have implemented the planning agent, which is used in Cyberscience for the creation of the course plan and for the planning of student actions in the virtual lab. We are planning to develop three or four more virtual laboratories with integrated intelligent learning agents. We will build one in microbiology, one in computer science and one or two in mathematics. Once these virtual laboratories will be created, we will then dissociate intelligent learning agents from the virtual laboratories to introduce them in the Intelligent Learning Agents Library then establish the connection between the virtual laboratories and the agents. The development of the set of intelligent agents involved in CyberScience will lead to a shell to easily implement intelligent learning agents systems. Most of the required features for each agent have already well known solutions. There are also numerous frameworks that already offer facilities to create agents and to give them mobility abilities. It is expected that a higher level of intelligence in behavior of the system would be achieved by close collaboration of these agents. It has to be defined how it should be organized to provide a generic functionality that would be reusable. Also, it must be established how would the specification for a custom system based on these agents would take place. With this shell the use of intelligent learning agents system is likely to widespread. But the first application it is used on, as a test case, is the Cyberscience virtual laboratory.

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Self Identified Motivations Of Online Learners Studying At Epiclearning.Com

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Abstract: The nature of online learning dictates that learners must be more self-motivated than in more traditional learning settings. This paper describes the self identified motivations of two learners who were participating in an online learning curriculum that had a duration of 15 months. Further, their experience involved a full complement of experiences that are currently available for online learning. The results indicate that to be successful, learners must have a great deal of self discipline, drive, and a clear understanding of how their success in this learning experience will reward them with a job that they desire.

The Learning Experience

The setting for this study was a training company in Atlanta, Georgia, Epic Learning, Inc. This company has moved their entire business focus to becoming a total online solution for technical training and is addressing such distance challenges and benefits. Curriculum previously delivered through modes that are more traditional is now delivered through the Internet. The student works through the curriculum's training plan to complete courses, readings, and CBTs in a self-paced environment. This environment is solely defined by the student and could be their home or office or a combination of both. The learning experience involves live lectures with interaction, live tutorial assistance, streaming CBTs, readings, labs and projects (downloadable from an ftp site) in addition to discussion boards and other communications technology (see, Orey & Koenecke, this volume, for more details about the experience).

Results

This study is two case studies. We summarize the motivations of each case below.

Paul

The first issue with regard to motivation is why Paul wants an MCSE. In response to this question, he said, "Primarily I am a goal oriented person from childhood and always setting goals. So, originally at 15 years old, 16, 17, I wanted to be a construction guy. So, I set a goal to become a plumbing contractor, and a pipeline contractor and a solar water heater contractor. So, I became one of those." This led to him starting and running his own business for 15 years. When business started to wane, he set a goal of getting into public works ("I work for the municipality where we supply underground water to the entire city...I do heavy construction, I run equipment."). He has worked in public works for nearly 10 years since setting that goal. He seems to enjoy his work, "I get to do everything, so it is really fun."

A central and important aspect of Paul is that he is a devout Christian. Even though he seems to be enjoying his work, he says, " ... a year and a half ago I just have been waiting and seeing where God would be directing me and I just really felt like I needed to make some more goals. I like computers and He put it on my heart and I went with it." His belief that God is directing him to move into the computer industry is a vital aspect of Paul's motivation. Of the three cases described in this paper, Paul was far and away the most advanced in his progress. He was the only one to have taken any of the certification exams and in fact he had passed three of the six exams required for the MCSE and he was in the process of preparing for the fourth exam. While his faith is not the only factor in his motivation, it is certainly something that he spent a considerable amount of time discussing.

Another important aspect of Paul's motivation was the fact that he had a pretty clear idea of what an MCSE did and he liked what he knew about the profession. He said that he had several friends who worked as MCSEs and one of them was his neighbor. He talked about the setup of the network at his neighbor's place of employment and he suggested at the end that his job is "astounding." Besides having friends who could serve as models of what is like to work in the profession, the friends also offered encouragement.

I think that a key aspect to Paul's progress was the network of support that he had in place at the time of the interview. Besides his wife (who shared the conviction that Paul was being led by God to pursue this career), his friends who worked in the computer industry both provided the model for what work in the field was like as well as moral support in continuing to with his studies.

At the end of the interview, we asked him what it takes to be a successful learner using the Epic Learning tools and he said immediately "commitment".

Teresa

Why study for your MCSE certificate? This question needs to be answered in context. Teresa is a fulltime stay at home mom. She is on the verge of leaving that endeavor for a career outside the home. This issue has two sides. One is to decide what you are interested in and what you would like to do for a living. The other side is whether you want to do it at all. In order to start a new career, you have to leave your old one. Changing careers is difficult for anyone, but to leave a career that has such strong emotional ties like those found between a parent and her children, is a very hard career change. You are not just giving up a job. You are letting go of your children, something that is always difficult for a parent. We will look at these two aspects separately for Teresa.

In regard to interest, Teresa says, "I have just been interested in computers and how they work, how they network. I have been real curious about it for a long time." She then begins talking about why she is giving up on fulltime parenting. So, we tried to get her to talk again about why she wanted to get an MCSE instead of any other career. Her response was, "it was something I could learn at my own pace...I can learn at home. I am interested in it. " She then began to talk about her volunteer role at the local middle school and her work with computers in that setting. Clearly, this work involved many aspects of computers and careers relating to computers (she was involved in technology planning, hardware upgrades, troubleshooting, and so on). It was clear that Teresa has an interest in the computer field in general, but she was not able to clearly articulate a reason as to why she wanted an MCSE in particular.

In regard to her changing role as a fulltime parent, "Now that my children are older, I have been thinking about going back to work. I want to do something that would be interesting. Since I have some time and I am able to take some time to learn something. It would be a good thing to do that instead of just go out and work right away." Later, we asked her again about changing her role as a fulltime parent. She said, "I have mixed feelings. If I wasn't a mom, I would be itching to get out there. But I have mixed feelings about making the choice between being easily available to my children as I am now, or working outside the home where communication with my children would not always be as easily available."

As the conversation continued, she began to explore alternatives to taking a fulltime job. "I don't have to just go right ahead and start fulltime. For instance, the school district has some part time positions and are very flexible regarding the needs of families." She later talked about consulting with people who were looking to setup home networks, that this consulting might allow for flexible scheduling of work.

We asked Teresa what advice she would give someone who was thinking about studying through Epic, she initially indicated that in general it was good. However, a physical classroom might be a better alternative for some people. "The classroom situation is a better way to learn, unless the instruction is too compacted and intense." She also indicated that her experience with Epic has been a positive one and that if a person chose to learn via the Internet that she would recommend Epic to them. With regard to personal characteristics that she believes are necessary to be successful at learning via Epic, she suggests that you must be "self-motivated." By self-motivated she means, "(you) are interested enough in something to be involved with it even when no one else is interested in you being involved with it." This comment led to the issue of whether she had family support in her studies which she assured me that they did. She suggested that her children were interested in both having more money and learning more about technology through her.

The Experience of Two Learners Learning at a Distance Via the Internet a la Epic Learning

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Abstract: This paper describes the experience of two learners who have participated in a year long course of studies on Microsoft networking. The experience was delivered entirely online via EpicLearning.com. These two learners had different expectations about the experience and therefore, they had quite different experiences. Paul was driven to complete his studies and used every aspect of the experience. Teresa was looking for more an online community and was disappointed in what she experienced.

The Epic Learning Online Experience

The setting for this study was a training company in Atlanta, Georgia, Epic Learning, Inc. This company has moved their entire business focus to becoming a total online solution for technical training and is addressing such distance challenges and benefits. Curriculum previously delivered through modes that are more traditional is now delivered through the Internet. The student works through the curriculum's training plan to complete courses, readings, and CBTs in a self-paced environment. This environment is solely defined by the student and could be their home or office or a combination of both.

Blended E-Learning^{SM}

With Epic's distance learning approach, the MCSE student receives a complete package with several components and a variety of learning experiences. Every student receives the same components regardless of their schedule or location. As part of this certification package a students receives the following:

- Dell Pentium III 450Mhz computer with NT 4.0 workstation - this allows the students to conduct hands on labs and practice the skills taught in the lectures, readings, and CBTs
- Online, live, synchronous instruction. Courses are delivered through a web browser and a product called Placeware. Instructors deliver live presentations with audio delivered either through a conference call or streaming audio. Students are allowed to ask questions and participate in interactive questions and answers. Courses are recorded for later review.
- Books - Microsoft Official Curriculum books and Teach Yourself Networking Visually.
- Streaming and downloadable CBTs - Students have access to NetG CBTs with interactive modules pertaining to the MCSE content. The CBTs contain pre and post-assessment tests, content, and an engine to keep track of completed sections and test scores.
- Homeroom - upon membership, students receive a web learning portal called a homeroom. This is a personalized web space where they can enroll and/or attend classes, launch CBTs, check their reading assignments, look at career options, etc.
- Training Plan - akin to the deliverables of a course syllabus, the training plan lays out a path for completion of all of the Blended E-Learning^{SM} components associated with that package. It is currently sorted by program week and will soon be even more flexible by various sorting methods. This will allow students to customize the way they view their progress in the course.

- Online coach - The online coach is very similar to a teaching assistant holding virtual hours and acting as a source of information and technical support. Each coach has successfully tested through the same material as the students and interacts via email, live chat, or phone with the students. The live chat feature even allows the coach to take control of the student's remote PC for demonstration and troubleshooting purposes.
- Study rooms- content specific bulletin boards are available for student chat. Students can ask/answer questions posed by their virtual classmates. Administrators moderate the chat and encourage meaningful participation.

The above components combine to make a very flexible program that meets the needs of a variety of learners. It is thought by Epic Learning that a majority of the learners choosing this method are likely to be highly motivated. If they didn't have time or distance constraints, they may have chosen a more traditional delivery method. This program meets the needs of busy people looking for convenience, flexibility, and hands on experience.

Results

Paul

When describing his learning experience with Epic, Paul contrasts his experience with others. Some of his friends have taken MCSE course work in a piece meal fashion. The result is that, from his perspective, they have wasted a lot of time and not adequately progressed towards finishing their certifications. For Paul, the Epic core is the Epic training plan (what he terms the Epic protocol). The "protocol" is a curriculum with each of the BL elements accessible from this page. It lays out the entire MSCE learning experience. Paul not only follows along on the web page, but he has printed out the "protocol" and has a well worn and marked up version of this plan on his desk. The epitome of his experience with the "protocol" was stated by Paul in this way. "They set up my whole agenda here and I have been just knocking them out."

In fact, he says that when he is working on a lab out of his book on his server computer, he often logs into a even if he has already passed the certification exam on that class, and listens in on the instruction. He says he does this, "just to listen to them and see what they are saying because as they are learning to teach they are adding stuff that I didn't hear originally. So, I am picking up on that." Another problem that he has run into is that he is one of the first students to sign up for the MCSE online with Epic and he is one of the people who is progressing the fastest. The consequence is that Epic does not have a core group that is that far advanced, so he often is left waiting for the classes to be offered when he has completed all the other materials for that step in the training plan. His response to that problem is, "that doesn't hold a good horse back."

Teresa

Teresa had a problem with the length of the Instructor Led classes. There was a lot of information packed into those two-hour classes. As she put it, " the two-hour presentations have so much information packed into them that a person does not have adequate time to think about and absorb the concepts presented. Especially when there are distractions. Shorter sessions may actually be more productive."

We asked Teresa what her usual way of going through a step was. Her answer indicated that she felt that she needed to be more systematic about it. Sometimes she would do the reading first, sometimes the Instructor Led class and sometimes the CBT. She also talked about retaking the CBT because a lot of time had elapsed or that she didn't really understand it the first time.

A complaint she had about the training plan was that the reading assignments in the training plan skipped around in the book, rather than proceeding directly through the book in order. She seemed to indicate that the structure of the curriculum was dictated by the structure of the CBTs. Because the CBT covered this now, the reading assignment might jump a few chapters to get to that same content. She liked the labs that she had completed and appreciated the help that she received from the coaches as she carried out those labs.

She indicated that she called for help and used the online help. She felt that the phone help was quicker, more elaborate and she was better able to be interactive in the process. For example, if she has a question while she is using her computers for a lab she can call an instructor who will guide her through the task in real time. They can work through the solution together more spontaneously than when using a computer chat session. The online help is good for questions regarding the understanding of the learning materials and for general guidance in following the curriculum.

Dr. Advisor: A Web Enabled Student Advising Resource

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Abstract: *Dr. Advisor* is a Web-based advising component of the UPJ Freshman Network, whose purpose is to improve freshman retention. *Dr. Advisor* eases students' transition from high school to college and enhances their ability to easily and quickly investigate the requirements of academic programs. This online advisory center includes components such as an interactive degree audit, major program requirements, directory of other advising resources, a FAQ, a QPA calculator, an Academic Calendar, and chat room.

Introduction

In an effort to enhance advising opportunities and to capitalize on the increasing technical literacy of entering freshmen at UPJ, the Freshman Network, a group of academic and student affairs professionals, created a Web-based advising center called *Dr. Advisor*. While live academic advisors are irreplaceable, some advising tasks do not require specialized academic knowledge. Automating these tasks allows faculty advisors to concentrate their efforts on more complex advising issues and creates a 24 x 7 advising resource for students.

Functionality

The most powerful and useful feature of *Dr. Advisor* is its ability to assist students' access to the volumes of data that comprise the College's Academic Program Requirements. This feature is being deployed in phases.

- Phase One: Program Requirements - This section of *Dr. Advisor* allows students to explore the requirements of every major program offered by the College. Selecting a *major* program from a pull-down menu displays a table of all *requirements* for that program. Each requirement is linked to a table of *satisfiers* (i.e., the list of courses that satisfy that particular requirement). Each *satisfier* is linked to both course *details* and *schedule* information.

- Phase Two: Unofficial Degree Audit - Students often change majors. The process of exploring new programs, while paying attention to how completed courses map onto new program requirements, can be very time-consuming. Each exploration requires an extensive audit that compares completed courses to program requirements.

Dr. Advisor will authenticate students' identities by accessing the University's Kerberos based authentication server. The academic history of the authenticated student will then made available to *Dr. Advisor*. This will enable *Dr. Advisor* to assist the student in conducting any number of "what if" scenarios.

The ability to analyze Academic Program Requirements is clearly the most sophisticated part of *Dr. Advisor*'s features. However, the system includes several additional features including a FAQ, an Advising Directory, the Academic Calendar, an interactive QPA calculator, a chat room where students can ask questions of trained student advisors, and an anonymous feedback component. *Dr. Advisor* provides much improved functionality and reduced costs over the printed form of these resources, the *Academic Source Book*.

The maintenance component of *Dr. Advisor* will be a Web-based interface to the tables and queries that define Academic Program Requirements. The Registrar is ultimately responsible for maintaining the course inventory, documenting program requirements, performing degree audits, and certifying graduation. This component will allow the staff of the Registrar's office to maintain and update the functions and operation of *Dr. Advisor* while preserving the integrity of the database architecture.

Implementation

In order to avoid the high cost of systems whose implementation requires the design of custom codes, the implementation of *Dr. Advisor* is based entirely on off-the-shelf products. These include Microsoft Access, ColdFusion by Allaire, and Keep Talking by UNET 2. The project is hosted on a Dell PowerEdge Server running Microsoft Windows NT Server.

The database design for *Dr. Advisor* focuses on ease of long-term maintenance and flexibility. The data system includes several key components:

- Course Inventory - This is a table that includes all college courses and their characteristics. E.g., History - 101 - Social Science - Entry Level - etc.
- Requirements - Each requirement is defined by a logical description of the course characteristics that fulfill that requirement. E.g., Requirement 23 = History or Political Science and not entry level. Each requirement is encoded as an SQL query. The execution of these queries builds the satisfier tables (list of courses) that are associated with each requirement.
- Requirement Clusters - A cluster of requirements defines the set of courses required by a particular entity. The entities involved include Division, Program, and Concentration. A Program Degree Requirement is a collection of entities. E.g., the complete set of requirements for structural engineering technology might include Engineering Technology division requirements + Civil Engineering Technology program requirements + Structural concentration requirements.

Academic programs, course offerings, and degree requirements change. This system has been designed to easily accommodate such changes. For example, a course may appear in many satisfier tables. If that course is removed from the curriculum, it is **not** necessary to seek each occurrence of that course and remove it. Rather, the course is removed from the Course Inventory, Requirement queries are executed, and all Satisfier tables are rebuilt, now excluding the deleted course.

Live demonstration and expanded paper at: http://dradvisor.upj.pitt.edu/webnet2000/

Case Study of a Multimedia CD-ROM Dissertation Web

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Abstract: With the advent of multimedia technologies, scholarly research has the potential to be interactive and multidimensional. Multimedia was used throughout the author's dissertation research process, as well as in the presentation of the results of the study. The oral examination was conducted through a multimedia presentation utilizing interactive HTML web authoring and Powerpoint. An introductory menu provided links to data analysis, Hyperstudio and HTML products of the case study participants, interview narratives and audio clips, tables, figures, chapters, titles, appendices, and references. The results of the study were preserved in a multimedia CD-ROM dissertation web.

The printed page has reigned supreme as the medium of choice for academic publishing for several centuries. Traditionally, a dissertation or thesis was typed, printed, bound, and stored on the researcher's university library shelf. As the technology for photography developed, the text of the document was preserved on microfilm in a central scholarly publication database. That research text was made available to fellow researchers and university scholars upon request. As personal computers became more accessible, word processing software was used to type the document and the text was saved digitally on floppy disk. As standardized cross-platform publishing formats were developed, the concept of digital libraries became a real possibility. With the development of HyperText Markup Language (HTML), a student author could incorporate multimedia elements: sound, graphics, video, animation, and interactivity. This paper examines the writer's use of HTML, Hyperstudio, and Powerpoint to create an interactive multimedia CD-ROM dissertation web: "Electronic Portfolios in Teacher Education" (Piper, 1999).

The digital revolution of the late 20th century stimulated dramatic change in the potential for libraries and universities to store and distribute data. McClintock (1999) compared the print culture traditionally supported in education with the possibilities of digital learning communities in "The Educators Manifesto." He described a new possibilities as a result of high-speed wide-area networks, linking people through ubiquitous computers to copious digital libraries, transforming the cultural conditions under which educational interactions take place." McClintock stated that, historically, the technologies of printing were of extraordinary importance in helping educators as they formed and spread ideas and ideals. However, he believed that "digital libraries, multimedia, and augmented skills have changed the limits of educational practice" (1999).

In addition, McClintock believed that ways of knowing are greatly expanded because of the "new media." He stated that "multimedia, and its extension in virtual reality, is not merely a glitzy vehicle for edutainment hype. It is an epistemologically interesting development in our culture." McClintock discussed the fact that the work of thinking has been related to "how people manipulate their spoken and written languages." He believed that multimedia allowed thinking to take place through many forms: "verbal, visual, auditory, kinetic, and blends of all and each." He stated that the new media was becoming more suitable for "serious intellectual work" (1999).

The possibility of submitting theses and dissertations to the university electronically was first openly discussed in 1987 in a meeting arranged by UMI. In 1996, the Electronic Theses and Dissertation (ETD) Project was formed to help graduate students and universities discover the potential for electronic publishing, learn about digital libraries, and improve the sharing of knowledge. The Networked Digital Library of Theses and Dissertations (NDLTD), originally supported by a U.S. Department of Education grant, has been devoted to improving graduate education and increasing sharing of knowledge through the development of digital libraries. By preserving theses and dissertations electronically, the NDLTD hoped to increase the availability of student research for scholars and to "empower students to convey a richer message through the use of multimedia and hypermedia technologies" (2000). Virginia Tech University became the first institution to begin requiring that students submit their theses and dissertations electronically.

Issues of standardization, format, sustainability, copyright, and accessibility continue to be addressed in a number of university, library, and government consortiums, initiatives, and projects. The standard accepted format at the beginning of the Virginia Tech project was Document Type Definition (DTD). Current formats supported by digital libraries include the Adobe Portable Document (PDF) file and the Standard Generalized Markup Language (SGML). With the advent of HTML and the number of user-friendly HTML editors, many students have begun to independently create products electronically. The popularity of HyperText Markup Language (HTML) fostered the writer's interest in creating a multimedia CD-ROM version of her dissertation. The writer published her dissertation traditionally due to the requirements and conventions of the university. However, the multimedia presentation was used for the oral examination and the final product was distributed to the dissertation committee in CD-ROM format rather than as a printed publication.

This research on the use of electronic portfolios in teacher education utilized various forms of technology throughout the study. The electronic portfolio project was developed in a small university teacher preparation program to explore the possibilities of using computer technology to store artifacts as evidence of achievement of course objectives. The electronic portfolio project was the final assessment for multiple subjects credential candidates enrolled in reading methodology classes during two consecutive semesters. The portfolio provided an electronic framework for documenting the meeting of course criteria, as well as evidence of self-reflection and self-assessment. Students included artifacts created with computer text, graphics, sound, or video as evidence of meeting each course objective.

The results of this study were presented in an interactive multimedia format. Text, data, literature references, figures, tables, and graphic images were saved as HTML within a portfolio web. Qualitative data generated from Ethnograph, including sample screens, were linked to an interactive table of contents. A Powerpoint presentation provided the framework for linking directly to the Hyperstudio and HTML portfolios of teacher candidates. The reading methods course objectives were linked to multimedia evidence within each student portfolio. Design templates, narratives, interview questions, the computer literacy questionnaire, and other research data were linked from menu options as well. Narratives were presented in audio format, as well as through interactive text.

In order to effectively present the research, as well as demonstrate the multidimensional electronic portfolio products, the researcher felt the study required an interactive, multimedia presentation. The ability to view student's multimedia Hyperstudio or HTML portfolio and hear the student voices as they responded to interview questions brought a sense of humanity and reality to the research process. The author did not intend to offer a linear sequential explanation of the research process from beginning to end. Rather, she wanted to link to significant data, figures, tables, charts, graphs, and pictures as the oral examination evolved or as specific questions were asked. The interactivity provided flexibility in the presentation and allowed the writer to link directly to appropriate data or resources. The dissertation CD-ROM provided an effective means of presenting the findings of the study. The qualitative methodologies used to examine interview narratives, reflections, expressions, and attitudes were made real through multimedia. This dissertation was stored and shared with the dissertation committee members in CD-ROM format. The oral examination of the dissertation data came to life through the tools of interactive multimedia technology. Electronic publication of theses and dissertations has the potential to change the face of scholarly research.

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BUILDING AFFECTIVE LEARNING COMMUNITY: SOCIAL PRESENCE & LEARNING ENGAGEMENT

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Abstract : The purpose of this study is to develop and implement a coding scheme for analyzing an online discussion for social presence indicators and levels of learning engagement involved in the discussion. Specifically, the coding scheme for affective learning and the design of the rubric for evaluating learning engagement has been developed. In addition to the aforementioned tools, the authors discuss the relationship between the participant's affective use of language and learning engagement. We hypothesis that a person's engagement in learning is a result of their social presence. The presenters contend that, using this study an example, social presence, the affective use of language, is of paramount importance to interactions, the prerequisite of knowledge building and catalyst of higher level of learning engagement.

Background

This research is based on asynchronous online courses offered by SUNY Learning Network (SLN). Our content analysis focuses on the discussion module of graduate level courses in the Educational Theory and Practice department.

"Rafaeli (1998; 1990) observes that social presence is an subjective measure of the presence of others, as Short, Williams and Christie(1976) defined it, while 'interactivity' is the actual quality of a communication sequence or context" (Gunwardena and Zittle, 1997). The affect in learning is the feelings, attitudes and behavior of the learner.(Bean, 1985). Social presence is the feeling that communication exchanges are sociable, warm, personal, and sensitive (Short, Williams and Christie, 1976). Social presence in an online discussion is defined by the affective characteristics provoked by the interaction in the knowledge building community. In our research we define social presence as a person's affective use of language. This language is categorized as, paralanguage, reflection, personal address, acknowledgement, closing, social sharing, humor, feelings, self disclosure, clarify, concern, and questions, social motivator, and value and distinguishes a person in an online discussion. Gunawardena and Zittle (1997) examined the interactions between students' use of emoticons, their perceived social presence, and their learning satisfaction. The results have shown that social presence is a strong predicator of students' satisfaction with asynchronous computer mediated communication (CMC). Additionally, Bloom states that if the student enters a course with a positive outlook, he or she will have a higher achievement level. This student is motivated to learn a new task is determined by the individual's perception of success (Bloom, 1964).

The construction of knowledge is not only a cognitive process in an online course. In order to have the interaction necessary for learning to take place, the students must be motivated to participate. Krathwohl, Bloom and Masia(1964), argue that "each affective behavior has a cognitive behavior counterpart of some kind and vice versa…Each domain is sometimes used as means to the other, though the more common route is from the cognitive to the affective." They summarize these ideas into five indicators; receiving (attending), responding, valuing, organization, and characterization. We believe these to be evident in an online discussion as cognitive indicators, which in turn promotes learning engagement Accordingly, in conjunction with the affective indicators, the authors have developed a rubric for measuring levels of learning engagement based on Mason and Garrison's critical thinking indicators (Mason,1991; Garrison, 1997). This rubric includes indicators such as, use of course content, building on another's response, use of own experience, outside information, and presenting new ideas (Mason, 1991). Garrison's five levels of critical thinking from the lowest level to the highest level are: elementary clarification, in-depth clarification, inference, judgement and strategy formation (Garrison, 1997). Based on Garrison's model of 5-stage critical thinking and Mason's proposal of criterion for evaluating conference messages, we were able to develop the indicators for different levels of learning engagement.

Learning Engagement is also evident in an online discussion based on the frequency of interaction and quality of the discourse. This engagement can be categorized as dysfunctional , where the response is counterproductive. This is evident through tangents, nonsense responses and frustration. The second level shows middle competency, and is called functional. There are two kinds of functional engagement. The first is structure dependent, where the author is compliant, and/or simply reproductive, and not going beyond content, second is self-regulated interests, where the author more often pursues his or her own interests more so than the instructors. This person discusses a high amount of personal experience. The highest level of learning engagement is critical engagement, where the person goes beyond the content, showing evidence of multiple perspectives, and integrating personal experience (Bangert-Drowns, 2000).The authors hypothesize that social presence provokes interactivity among knowledge building communities and that social presence is an affective measure of the presence of others in an online community. An engaged learner is thinking critically, therefore building knowledge.

Methodology

The authors reviewed an online discussion for both affective and learning engagement indicators. After having read through the discussion, we noticed characteristics such as addressing the sender, self-disclosure and paralanguage, as mentioned above. There were a total of 110 messages, which were coded sentence by sentence for the social presence indicators. Then, we evaluated the level of learning engagement based on the entire message. This was done individually by the two researchers, then final ratings were discussed and agreed upon together.

Results and conclusion

Out of the 110 responses from the 35 students, 144 sentences included affective indicators such as acknowledgement (42), personal address (27), reflection (26), paralanguage(24), and clarify, concern, and question(25). This confers our hypothesis that 'Social presence is an affective measure of the presence of others in an online community.' In addition, frequencies of learning engagement indicators were counted and analyzed. All the responses are rated at the functional level or critical engagement level of engagement. Those students who use inference, alternative perspectives and integration are highly engaged in the online discussion.

A student who cares about others and the knowledge building community in which he or she participates versus a person who does not, stands out among the others. In order for a knowledge building community to be highly engaged it must include a high amount of affective, such as paralanguage, values, and acknowledgement. Our findings of the level of engagement involved in the discussion corresponds to the amount of the affective indicators used. Critical thinking is a prerequisite of learning engagement. Those students who indicate to the researchers that they are engaged are both intrinsically and extrinsically motivated, through self-efficacy and affective motivation.

Due to the fact that this is a pilot study, our survey questions and rating scale has yet to reach its maturity. We believe that the students must also be surveyed for perceived engagement, as well as student perceptions of other students. The correlation between social presence (affective indicators) and learning engagement(critical thinking) determines an affective learning community. An online discussion would not be successful without the presence of affective use of language. We believe that social presence predicts learning engagement, which in turn determines learning outcome.

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Case Studies to Enhance Quality in Web Activities

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Abstract : On-line activities (case studies, peer assessment and distance training) proposed in a course to graduate students are described and evaluated as examples of quality enhancement. The impact on students' performances, the level of competencies they develop, the role of tutors and the changing relationship student-tutor-course are highlighted.

Introduction

In Belgium, distributed learning is still in its pilot phase but expands increasingly from day to day. The University of Liège has launched the LabSET (Support Laboratory for Telematic Learning), helping faculty members develop their own courses on a distributed platform (WebCT). Active learning and rich communication scenarios are promoted, contrasting with the mass of distance courses available on the web.

Illustration : "Edumetrics and School Assessment"

An example of this quality enhancement is illustrated by the on-line activities proposed in the course of "Edumetrics and School Assessment" (ESA). Graduate students use WebCT to build case studies and answer their peer's cases. They play alternatively student's and tutor's role, learning how to manipulate the platform and how to be an efficient on-line tutor. The methodology is a combination of case study analysis, peer assessment (tutor and student role for each student) and distance training.

Evaluation

The evaluation of students' achievements was threefold. For each student, we evaluated :
- the quality of the case study produced (realism of the case, coherence between text, title and graphical illustration, creativity, relevance of the 11 questions on the case, clarity, precision of the language, adequacy of style) ;
- the quality of interactions displayed by the student in the discussion forums, both as a tutor and as a student (respect of the initial instructions, availability as a tutor, relevance of the interactions, correctness of the affirmation, openness to reconsidering once initial position) ;
- the mastery of the content (first chapter of the course), through the whole process and through an oral exam.

Those three notes for each student give a good indication of the separate performance for each set of criteria. The final note was a combination of the students' results for the three sets of criteria.

Additionally (but not taken into account in the final note), an open-ended questionnaire was proposed to collect their thoughts and feelings about the distance training situation, the case study analysis, and this course in particular with its quite demanding methodology.

Findings

Our findings can be described in terms of a pedagogical model, the "Competencies Architecture" (LECLERCQ, 1998). The model, represented as a pyramid, distinguishes four levels of competencies :
Dynamic competencies : involvement, interests, willing, hate, motivation ;
Strategic competencies : self knowledge, especially in problem solving ability ;
Demultiplicative competencies : general technical skills ;
Specific competencies : knowledge and abilities, content related.

Our objective was that not only the first (specific) level should be stressed but each of the four levels has to be developed for itself, since distance learning is a powerful tool that, if well designed, can serve the development of the four levels of competencies.

Mastery of the content (*specific competencies*) by the students is better in '99 than in '98. "Time on task" is higher, which partly explains the gain, but the mastery is also deeper, students being able to criticise the model itself and to have a real dialogue with the professor and researchers on how to improve the handbook. This quality in the content mastery is not only due to the time on task but also to the methodology used, forcing the students, in their tutor's role, to advise others, to adopt definite positions and make decisions, to go back to theory, to relate it to practical cases and to confront the model to reality.

The students have learned how to use an integrated distance learning platform, with its forums, chats, e-mails, glossary, calendar, personal presentation pages, hot links, formative quizzes, formative tests and other specific tools. Those *demultiplicative competencies*, largely transferable to other contents, were not present in the former course and constitute an important capital for our students in education.

Distance learning is an experience to live more than to talk about. Having participated in an on-line forum, having entered his/her own password to access a reserved space, feeling part of a group that never physically meets are experiences that our students were living for the first time and probably will never forget. Interviews reveal that their self image has been positively modified, with an impact on their ability to really learn in such an environment (*strategic competencies*).

The pedagogical setting (case studies, role changes) as well as the distance training environment were seen by the students as very motivating. Being part of an innovative experiment and being aware of their progresses and difficulties were also helping the students build their *dynamic competencies*. They knew they could influence the process, the course in itself and even its content, they were real partners of their own learning process, driven by such an empowerment. Those high level competencies are the impetus of learning, allowing the three other types of competencies to develop. The dynamic competencies should always be a priority.

In order to highlight possible problems and to improve the content of the course for the next academic year, we also analysed the number of time the students had hit each of the HTML page of the content. This helps us know what students find useful, what they ignore and change it accordingly.

We also noted a difference (correlation 0,5 explaining 25% of the variance) in the final scores between the students having highly interacted in the discussion forums and those having not : those involved and contributing in the course having better final scores. Encouraging students signing in the course, interacting and participating in the activities should therefore be a priority.

Conclusions

This methodology has demonstrated its efficiency, although we can't perfectly isolate the role of each factor (distance learning platform, case study methodology, peer assessment, consciousness of being part of an experimental design) in the global result.

Specific but also demultiplicative, strategic and dynamic competencies were developed, more easily than in a traditional class setting. We know that those "transversal competencies" are highly appreciated by the future employers of our students, the other specific professional skills being often taught "on site".

The quality gain seems also to be partly due to the better definition of the activities to perform, of the objectives, of the evaluation criteria and of the deadlines. Distance learning forces the tutors to be precise, coherent, available, correct and equal , since every single piece of information communicated on-line can be printed as a proof and can be used for discussion or for arguing. This quality control by the students is sometimes challenging for the tutor but helps define, clarify and improve the training process.

Finally, the use of an integrated platform really helps monitor the course, analyse the students' results and improve the course offering from year to year, not only as a consequence from direct students comments but also in response to the way students are interacting with the course. It plays an important role in the quality gain we underline.

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A New Metaphor for the Spread of Innovation in Teaching and Learning

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Abstract: A new model for the spread of innovative uses of technology in teaching allows for the simultaneous transfer of both new ideas about teaching and tools that support these ideas is outlined. The model postulates that faculty using technology may form a network that has rich connections and provides feedback. Support for the spread of innovation should focus on reaching a critical number of participating faculty to form the network and maintaining reliable technology support.

The diffusion of innovation model

Much of the discussion about the spread of new methods in educational technology has been based on the model for the diffusion of innovation. The model is very useful because it divides the faculty into different categories with respect to their ease of adoption of new technologies (innovators, early adopters, early mainstream, late mainstream and laggards). The reported "chasm" (Goeghegan, 1994) in the diffusion of innovation is of critical interest to faculty development efforts and expectations for the spread of new instructional technologies. The chasm represents a barrier to diffusion observed in many systems and seems to hold in academic settings.

The diffusion model for faculty development implies that the transfer of information flows from innovators to early adopters (as in diffusive mass transfer) but that there is difficulty translating that into action and acceptance by the early mainstream faculty. Previous efforts in faculty development (including our own efforts) focused on trying to help bridge this "chasm" through workshops and other activities.

Spread of new approaches through connectedness

We are proposing a new metaphor for the spread of innovative uses of technology in teaching and learning that depends on the connectedness of faculty. The underlying model is that of transferring information in a network of faculty and is based on complex networks (Kauffman, 1993). Nodes, links, and feedback play critical roles. Faculty can be viewed as nodes and links represent the rich connections that each faculty makes. The degree of connectedness may be easiest to visualize as a landscape in which adjoining areas are either closely connected or separted by gaps. Closely connected areas might be academic departments whereas the gaps might represent physical or disciplinary separations that inhibit communication and sharing of teaching activiteis. A forest fire in rugid terrain is a fitting metaphor in that innovation is not going to necessarily affect all of a particular person's neighbors but it may catch on in different areas. As the number of total connections approaches the number of faculty, the structure begins to crystallize (all faculty become very connected with each other). One of the final characteristics of connectivity is the development of feedback loops to provide information on the impact of changes to courses. Increased rich connections lead to shorter radius, more feedback, and shorter feedback loops. Even though the spread of innovation is thought to be beneficial, the homogeneity that comes from over-connectedness should be avoided. Just as a fire sweeping across a forest may leave small parcels of landscape that serve as innoculum for subsequent growth, continuous innovation may require small areas that are not always being buffeted by sweeping change.

The "network" metaphor recognizes several shortcomings with the "diffusion" model. The diffusion model is based on early research in agrarian systems that studied how new methods were communicated in rural society. This model has been applied to technology such as the use of word-processing skills but it is still a unidirectional process between people that interact with each other and exchange information as a part of their normal activities. The network model incorporates our understanding of how technology has fundamentally changed both the level of connectedness between people and the types of processes and products that can be conveyed over those links. For example, a teacher can develop a web-site that can be accessed by several of his or her colleagues at their convenience and that web-site can include products and tools that can be transferred over the same channel as the information.

Many faculty only have rich connections within their own department or discipline. A "rich" connection is one that can provide for the reciprocal exchange of teaching content and methods. This situation will limit the broad dissemination of new teaching/learning strategies and in particular may even restrict the exchange of teaching/learning techniques that are not discipline specific. Some departments have their own computer labs for using educational technologies. Although faculty may develop new methods in these labs, they will not be visible and potentially not very portable to other disciplines.

Instructional technology has two aspects that help form rich connections across disciplines. First, the information about teaching is freely available, such as posting of syllabi on the internet. This availability of information makes the process of teaching more visible to peers in the same department, other departments, and other universities that may require those courses as prerequisites. The second, and a very important, way that that information technology can help is that the tools can be transferred along with the content. For example, if you use a Javascript page to explain a particular concept, other faculty can link to that web page from their course website and can use essentially the same instructions to do a different or follow-up exercise. The reusable aspects of our digital technology are a crucial characteristic that makes the spread of innovations with digital technologies different from spread of innovations in previous process or analog technologies.

Practical implications

Based on the network metaphor presented above, efforts to help faculty develop in their uses of information technologies (in particular digital technologies) should be focused in a different direction than if the diffusion of innovation model is used. The emphasis in the previous mode was to help some faculty to "bridge the chasm". In the network model the focus should be to develop a critical number of people using new teaching methods and make sure they are interacting with each other. A crucial parameter in both models is reliable support. This metaphor for connectivity and innovation also emphasizes the value of continued innovation as a force in progress.

We have developed a list of immediate actions for faculty, faculty development staff, information technology administrators and academic administrators. We think that the three most important things you can do if you are a faculty member are; 1) make your teaching as public as possible, 2) work with several colleagues on teaching, and 3) take time to find out what technology is working and show your appreciation for those people who keep your network running. Along a similar line, we think that one of the most important ideas we can suggest for faculty development activities is to plan events that make teaching highly visible and provide an opportunity for teachers to share what they are actually doing, not just focusing on the technology. Information technology administrators and university administrators can also help support building a network of faculty and the spread of innovation though reliable support for infrastructure, budgeting and using appropriate faculty incentive models.

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Web Based Learning Environment: an Example

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Abstract: Telecommunications, seen as access to information nodes and to remote resources, was at first an experience reserved for the few. Now it has become a very cheap resource available to all. In just a few years, it has led to the development of a planetary web, a distance communication highway connected by the famous Internet, "the net of the nets". Internet has changed the process of communication in these years, and it is usually now to buy the books in "virtual book stores" or to research information on physics and mathematic problems using the "net". The explosive growth of the Internet and the convergence of information and communications technology is opening up new educational opportunities. Internet can be used to modify the teaching methods and the process of learning that involves synchronous and asynchronous education. This work is devoted to present how to use the Web and its resources in the learning in a high school. I refer an experience in a technical institute in Italy with a sample of 15 students (age 16 - 17). The target was to stimulate the Web learning environment. For this reason the project has been divided in different phases: the knowledge of the Internet, the didactics using the Internet, the collaborative hypertext, and the communication with Internet.

The knowledge of Internet

In this first phase I have proposed to my students an entry multiple choices test to control their knowledge of the Internet. After the students have started the knowledge of the Web directly in the Web. In fact I have proposed to my students some special interactive lessons on line, developed by the Department of Science of Information at University of Milan, at the Internet address:
http: // twilight.dsi. unimi.it/ Users/sdi/barbacovi/prog1/Lezione/indice.html
Using these interactive lessons the students have learnt the correct navigation in documents organised like hypertext, how to research information using the search engine, and the netiquette. I have dedicated to this training phase 4 hours and after I have proposed to the students a multiple choices test to control their learning rate. The comparison between the entry and the final test has demonstrated that the students have reached the educational goals which I have established before :

Question number	1	2	3	4	5	6	7	8
Correct answers (before)	7	6	5	6	4	2	4	6
Correct Answers (after)	15	13	14	15	14	15	12	15

The didactics with Internet

World Wide Web (W3) is a hypertext-based information retrieval mechanism providing information access across heterogeneous platforms mainly connected over Internet (Berners-Lee, 1992). It is based on the philosophy that information should be freely available to anyone. For this reason in the second phase the students have analysed the capability to download and to use some educational software shareware and freeware in their educational process. In the this phase the students have also studied using educational Internet sites dedicated to the Italian literature, to the mathematics, to the geometry, and to the theory of the hypertexts (Sala, 1999). After this phase I have proposed a multiple choices test to control the students' learning rate (on concepts of mathematics, physics, hypertexts that the students have seen using only the Web) .

Question Number	1	2	3	4	5	6	7	8	9	10
Percentage of correct answers	70%	80%	67%	90%	80%	85%	90%	100%	85%	95%

Collaborative hypertext

During this educational approach the students have created a collaborative hypertext (HTML and Java-Script procedures) dedicated to Bonaventura Cavalieri (1598 - 1647) (an Italian mathematician) for an International Conference of Mathematics. The hypertext development comprises these steps: the bibliographical research of information (using traditional textbooks or Internet), the choice of information to put in the hypertext, the hypertext's story board; the realisation of the graphics interface, the encoding of information in digital form, and the control of hypertext (logic organisation, links, hot words, and so forth).

The students, organised in seven work groups, have developed the following topics: Cavalieri's biography, Cavalieri: the religious figure, Cavalieri's scientific production, Cavalieri and the town of Verbania, Bibliography, Other sites on Cavalieri (with some links to other Internet sites). The hypertext has been written in two languages: Italian and English. It can be read at the Internet address:

http: // www. verbania.alpcom.it/scuole/cavalieri/cav0e.htm

After this phase we have proposed to the students a multiple choices test to control their learning rate (on Cavalieri and his mathematical studies, and on hypertext theory).

Next table contains the percentage of the correct answers.

Question Number	1	2	3	4	5	6	7	8
Percentage of correct answers	100%	93%	93%	100%	100%	80%	93%	87%

This approach is an example of "Learning by Doing" environment because the students have built, during the hypertext development, their knowledge on Cavalieri and on the history of mathematics. Creation of lecture materials as Web pages has the following benefits (Lee et al. , 1998): the lecture materials can be manipulated electronically such as reviewed, stored, delivered, and edited; students are able to follow hyperlinks while reviewing materials, lecture materials can be more powerful than usual due to the inclusion of animations.

The communication using Internet

Communication can be viewed as existing on a continuum based on the comprehension by the receiver of the message being sent. Computer-mediated communication is no different. By viewing the Internet as the communication facilitator, the communication effort can be assigned a location on the continuum based on two separate input criteria. The rapid growth of computer and fax machine usage in schools has increased long-distance communication between faculty and students (Mackwood, 1994). Students can now communicate with their instructors by the use of electronic mail. The final phase of our project has been dedicated to the communication with other European schools using the e-mail. In particular manner, a disabled student has used the "net" to search "cyber-friends". He has found some Italian and Swiss "cyber-friends". Internet became for him a new way to socialise and to overcome his handicap.

Conclusions

Rapid advances in computer hardware and software continue to pave the way for new and innovative designs in technology based instruction. The increasing importance of distance learning in higher education has led many colleges and universities to incorporate distance courses into their education curricula. Distance learning, open learning, and collaborative learning certainly were born in a pre-telecommunications era. They, nevertheless, can find in telecommunications a source for enrichment, development and substantial modifications. Telecommunications brings informative and remote resources, as well as permits equal participation and interaction among individuals of different cultures, sex, age, and religion. "Despite the growth of technological possibilities, there exists a certain scarcity of conceptual models relative to the employment of telecommunications in the learning processes " (Olimpo, 1992, p. 7). There is, first of all, a discrepancy between the actual rhythm of technological innovations, which are necessary for mastery and integration of technologies into every day activities, and the internal slowness of the cultural transformation. Second, we find an innate resistance in the school world to understanding and using new tools, methods, and resources. Finally, we find a certain incapability in the technological world to present practical applications for the new tools that it makes available. These difficulties have often contributed to wide conceptual and operational discrepancies between technology and education. For these reasons our project is an attempt to plan a new educational approach where the "net of the nets" occupies an important position.

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ELECTRONIC MAIL IN THE WORKPLACE: EMPLOYEE RIGHTS AND EMPLOYER PROTECTION

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Employees and employers often incorrectly assume that email messages disappear after deletion. Rather, deleted email will remain on the computer's hard drive until the 'trash' directory is emptied, or will be stored and retrievable on a server as backed-up files. If the content of employee email is inappropriate or illegal, the employer may face potential liability under basic principles of agency law. An agency relationship is formed when one person – the agent – is authorized by another person – the principal – to act on behalf of and under the control of the principal. According to the doctrine of *respondeat superior*, a principal-employer is vicariously liable for the unlawful acts of an agent-employee when the agent-employee commits the acts within the scope of his or her employment. Thus, email containing sexual or racial content that tends to create a hostile work environment may lead to claims for unlawful harassment. Email containing false statements about another's reputation may lead to a suit for defamation. An employer could be subject to criminal prosecution if an employee sends child pornography using employer email. Additionally, an employer may be sued for copyright or trademark infringement if an employee reproduces, distributes, or otherwise misappropriates protected materials in email. An employer who is aware of this potential liability will want to take steps to reduce his or her exposure to liability for the consequences of employee misuse of email. However, any employer will also want to avoid employee claims for invasion of privacy based on the employer's regulation employee email.

Potential Sources of Employee Privacy Rights

The possible sources of employee privacy rights in the private sector are quite limited. The Fourth Amendment to the United States Constitution, which requires probable cause as a prerequisite to searching files, desks, lockers, or offices, does not apply to private sector employees. In addition, the Electronic Communications Privacy Act (ECPA), 18 U.S.C.§ 2701(a)(2), states: "whoever (1) intentionally accesses without authorization a facility through which an electronic communication service is provided; or (2) intentionally exceeds an authorization to access that facility; and thereby obtains, alters, or prevents authorized access to a wire or electronic communication while it is in electronic storage in such system shall be punished [by fine or imprisonment as provided]."

An exception in the ECPA directs that "the person or entity providing a wire or electronic communications service" is exempt from its restrictions. Since an employer that provides an electronic mail system falls within this exception, an employee will have no remedy under the ECPA. The case of *Andersen Consulting LLP v. UOP*, 991 F. Supp. 1041 (N.D. Ill. 1998), illustrates how the ECPA exception applies. Andersen was a consulting firm hired by UOP to perform a system integration project. During the course of the project, Anderson's employees were given access to and regularly used the UOP email system. Subsequently, UOP terminated the project and sued Andersen for fraud, negligence, and breach of contract. During the litigation, UOP divulged the contents of Andersen's email to the *Wall Street Journal*, which published an article entitled, "E-mail Trail Could Haunt Consultants in Court." Andersen then sued for violation of a section of the ECPA that directs that "a person or entity providing an electronic communications service to the public shall not knowingly divulge to any person or entity the contents of its communications while in storage by the service." The court dismissed the suit on the grounds that UOP's internal email system was not "public" and therefore UOP was free to access and reveal email sent by Andersen employees using the system.

Alternatively, state tort law may afford a remedy for invasion of privacy. One is liable for invasion of privacy when he or she unreasonably intrudes upon an area or the affairs of another person in which that person has a "reasonable expectation of privacy." The touchstone of this claim is proof that the plaintiff reasonably expected that the area in question was private. For instance, the plaintiff in *Smyth v. Pillsbury*, 914 F. Supp. 97 (E.D. Pa. 1996), claimed he had been wrongfully discharged in violation of his right to privacy after Pillsbury had told employees that their email was confidential and would not be used against them. Smyth later sent an email to his supervisor referring to management as "those backstabbing bastards." In dismissing Pillsbury's case, the court wrote: "Once plaintiff communicated the alleged unprofessional comments to a second person (his supervisor) over an e-mail system which was apparently utilized by the entire company, any reasonable expectation of privacy was lost. ... [P]laintiff voluntarily communicated the alleged unprofessional comments over the company e-mail system. We find no privacy interests in such communications."

Likewise, the court in *McLaren v. Microsoft Corp.*, 1999 Tex. App. LEXIS 4103 (Tex. Ct. App. May 28, 1999), reached the same result. McLaren was a Microsoft employee who was suspended from work pending an investigation into accusations of sexual harassment. He requested that no one access his email and later sued, claiming that Microsoft had invaded his privacy by "breaking into" the personal file folders in which he stored his email on the network. The court dismissed his claim after observing that even though McLaren had stored his email in "personal folders," the messages were first transmitted over the network and at that point were accessible to third parties. The court added: "[T]he company's interest in preventing inappropriate and unprofessional comments, or even illegal activity, over its e-mail system would outweigh McLaren's claimed privacy interest in those communications."

Implementing an Employee Email Use Policy

Employers that provide use of an email system to employees should adopt and disseminate a written policy that clearly communicates the employer's directives regarding personal use of email and that limits the content of employee email to business purposes. In particular, the policy should be widely distributed and should emphasize that the email system, both hardware and software, and all electronic communications are the property of the employer. The employer should also make clear in the policy that the email system is made available for business and work-related purposes only, and that use of email for personal or other uses is considered a violation of the policy.

In addition, employees should be reminded in the policy that no email is considered to be private and confidential, unless it is necessary to protect information considered proprietary or sensitive by the employer. The policy should inform employees that email may be used as evidence in law suits and that content that amounts to defamation, sexual or racial harassment, or copyright infringement may lead to legal liability for the employer and, quite possibly, the employee as well. Further, the employer should require a signed acknowledgment from each employee that he or she has received and read the policy. Employers should issue all email passwords and prevent employees from using passwords unknown to the employer. It is advisable to secure the email system by using firewalls or encryption for email containing trade secrets or other information considered confidential.

Employers may also want to consider monitoring email to enforce these restrictions. Email monitoring in the workplace may seem like an extraordinary means of enforcing an email policy, but a growing number of businesses do this on a regular basis. Should an employee challenge a disciplinary action or termination in court, the court will be most concerned with whether the employee had a reasonable expectation of privacy in email. In such a instance, employers that can produce a written email use policy and justify monitoring as a means of ensuring compliance with policy will be at an advantage; they can prove that the employee did not have a reasonable expectation of privacy and that the employer had legitimate, business-related reason for monitoring and taking action against the employee. If an employer decides to monitor, then employees should be given notice in writing that the employer may review email at any time and for any reason without prior warning to the employee. A formal email use policy, along with warning that actual monitoring occurs, allow an employer to control its email system and while laying the groundwork for later disciplining or terminating an employee who abuses it. Furthermore, if monitoring is part of an employer's overall policy, it is important that it be done consistently in order to be of maximum protection to the employer and to prevent charges of employment discrimination. Likewise, employers should assess the ethical considerations involved in adopting a policy.

Informational Graphics Within a Distributed Learning Environment

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Abstract: Information presented in distributed learning environments has always been done through uninspired methods. In order for a student to optimize the intake of the information presented, there must be a significant adjustment in information representation and knowledge transference. Informational graphics are imperative for this successful representation and optimal understanding of the learner.

Introduction

Since Vannevar Bush "invented the foundation for the World Wide Web in 1945 and founded much of the early thinking about human-centered computing" (Nielsen, 1999, paragraph 2) through Ted Nelson as a "pioneering and vocal advocate of users' right to simple computers that everybody can figure out and use as a communications medium rather than a glorified calculator" (Nielsen, 1999, paragraph 2), the movement towards a distributed learning environment has been steadily developing. Distributed learning environments are developing into viable options to face-to-face learning situations due to the ease of access as well as the associated lowered costs; for the traditional, physical environments, buildings with allocated classroom space must be available for face-to-face learning. Numerous issues must be addressed within these new environments to obtain successful learning results. One such issue is the appropriate use of informational graphics. The careful, thoughtful implementation of informational graphics emphasize the visual learning aspect of a learner's environment, as well as the further development of a simplistic conceptual framework to deliver deliberate information. Careful consideration of theoretical underpinnings, design issues and development issues must be considered so that the learner receives appropriate guidance through the informational graphics contained with in the learning environment.

Significance

The significance of informational graphics within a distributed learning environment cannot be emphasized enough. Learners must develop a mental model of understanding, a framework that integrates information, so as to develop the ability to access and use information at levels of higher thinking that are necessary and required for learning as well as the development of appropriate information structures. Such significant elements must be carefully examined so as to integrate appropriately informative graphics within the distributed learning environment. The significance of informational graphics within a distributed learning environment pertains to two main areas of information presentation: organization of knowledge and graphic representation.

The organization of knowledge is imperative for a learner's understanding of the information presented as well as the learner's development of conceptual framework for future understanding and reference. The information presented to the learner has already been "chunked" by the instructional designer, meaning that the information has already been contained within appropriately sized bits so that the learner can more easily conceptualize the meaning of the information. But how can the learner get an enhanced overall feeling of the main points being presented? Informational graphics offer the solution to this quandary. As speakers and writers always emphasize: tell them what you're going to tell them, tell them, and then tell them what you told them. This organization of knowledge within a graphical representation is imperative towards the appropriate development of the learner's mental model and conceptual framework. Only the major points must be represented in the informational graphic to aid in conceptual framework development; the finer points of information should be represented elsewhere within the instructional environment.

Design Issues

As stated by Nielsen and Norman, "On the Internet, it's survival of the easiest .... It's cheaper to increase the design budget than the ad budget, and attention to usability and increase the percentage of Web-site visitors...' (2000, paragraph 1). This is true within numerous environments but especially true within distributed learning environments, specifically a Web-based learning environment wherein the development cycle is at breakneck speed. As has become a distinct feature of discussions surrounding the use of the Web, "People often talk about how the Web changes on 'Internet time', but usability issues seem to change much more slowly since they stem from human capabilities and interests" (Nielsen, 1994, paragraph 2). Design is an imperative part of the product development cycle, wherein "the key issues in interaction design and the main determinant of usability is: what to say" (Nielsen, 2000, paragraph 5). The design phase of a distributed learning environment must include consideration surrounding the integration, placement, and abundance of graphics and consistency of design. Through the thoughtful consideration of these aspects, informational graphics will aid the learner's understanding of information.

Development Issues

Informational graphics within a distributed learning environment must represent the positive attributes of Web design and development, rather than the negative aspects of the Web. Although learners have a vested interest in the Web site they are navigating, the bandwidth issues must be a consideration when developing informational graphics. The aesthetic value of an informational graphic must be weighed against the usability features that are imperative to the success of the learner within a distributed learning environment. Therefore, the careful presentation of informational graphics within a consistent visual design must be represented through out the learning environment to aid the learner in the successful navigation and attainment of information within the Web site.

Conclusions

The focus of distributed learning environments is twofold: the presentation of information in appropriate and useful formats, and to aid the learner in the understanding and development of appropriate conceptual frameworks. The focus of distributed learning environments is the learner, as is the focus of face-to-face learning environments. The representation of information within graphic formats must be emphasized within distributed learning environments to ensure the appropriate presentation of information for the learners as well as the development of appropriate mental models and conceptual frameworks.

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Developing Metaphorically Inclusive Graphics Within an Informative and Visually Engaging Web Site

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Abstract: The development of metaphorically inclusive graphics within an informative and visually engaging Web site is a difficult venture to undertake. The thoughtful consideration of numerous issues through out the design and development of a Web site enhances the underlying metaphor and, ultimately, aids the user towards an understanding of the presented information. Imperative towards the understanding of the development of metaphorically inclusive graphics within an informative and visually engaging Web site are four realms of interest: definition of metaphor; creativity; information context; metaphors on the World Wide Web; and, an informative and visually engaging Web site.

Introduction

The development of metaphorically inclusive graphics within an informative and visually engaging World Wide Web (Web) site takes on numerous meanings within the varied and adaptable world of the Web. Numerous opportunities for metaphorically inclusive graphics have arisen over the previous five-year period due to the amazing and varied growth of the Web, but the introduction of metaphors into the realm of communications is not unique. Samuel Taylor Coleridge, who lived from 1772 until 1834, stated that

> The imagination … that reconciling and mediatory power, which incorporating the reason in images of the sense and organizing (as it were) the flux of the senses by the permanence and self-circling energies of the reason, gave birth to a system of symbols, harmonious in themselves, and consubstantial with the truth of which they are the conductors. (As quoted by Veale, 1995, paragraph 1)

Due to the strength of metaphors within informational models of communication, a discussion revolving around the development of metaphorically inclusive graphics within an informative and visually engaging Web site is appropriate.

Definition of Metaphor

The term metaphor can be defined numerous ways, depending upon the realm in which metaphors are discussed. For the purposes of this paper, we will define metaphors as integral to user interface design and an environment in which information can be presented in an understandable fashion, so as to aid the user in developing an understanding of the information being presented and to aid in the development of a mental model of understanding. Metaphors may also carry an imaginary, creative aspect to them that aid the user in the further development of information usage and understanding. Creativity is an aspect of human thinking and intelligence that directly parallels the integration of metaphors within a learning environment. The creativity emphasized through the use of metaphors towards the further understanding and integration of information is imperative towards the contextual situation that drives the human to conceptualize the information into mental models of understanding.

Information Context: Getting the Information Across

Metaphors offer the ability to frame information that may be new to a user in such a way as to make the information more understandable, such as the parallel association of unknown information with something with which the user is already familiar and has already established a comfort level. "Human beings are fundamentally metaphoric animals, and all our creative intellectual endeavors (including both software and philosophy) are constituted by the patterns of bodily feelings which motivate metaphors. The metaphors we use to understand ideas, minds and user interfaces are not separable from the 'things themselves'" (Rhorer, 2000, paragraph 13). Due to the integration of metaphors within the majority of everyday aspects, the introduction and implementation of metaphors within a Web environment is a natural leap of brilliance.

Metaphors on the World Wide Web

The growth of the Web over the previous five-year period has bypassed countless expectations. The information available on the Web is expanding exponentially; however, such information is not always well implemented or understandable to the user. The use of graphics and terminology to enhance the Web-based metaphor is a natural extension of the conceptual modeling that occurs for the user. A well-designed Web site more often than not institutes the user of a metaphor through which the user will develop a sense of understanding and guidance. This will enhance the user's use of the Web site and emphasize an emotionally positive reaction to the Web site experience; however, the emphasis of the Web site is the transfer of information to the user. "On this view metaphor is just another way, possibly a very helpful way, to transfer into the users mind the model of the program the designer thinks the user should have" (Rohrer, 2000, paragraph 12). An informative and visually engaging Web site must carefully implement the use of a metaphor that aids the user in the understanding and retention of inclusive information.

Metaphorically Inclusive Graphics

Within a Web site, the information presented to the user is of utmost importance. But the graphic representation of information within the same Web site must also be a careful consideration. The environment in which the user finds himself/herself must be creatively and conceptually sound, so as to emphasize the appropriate information for the user. The metaphor cognitively activates the user's understanding of the environment during the user's perusal of the information contained within the Web site.

Conclusion

Developing metaphorically inclusive graphics within an informative and visually engaging Web site is of primary importance to the clarity and understanding of information that must be appropriately represented and obtained by the user. Through the careful, thoughtful consideration and implementation of metaphors within a Web-based environment, a visually engaging and informative Web site offers numerous avenues of understanding to the user.

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KNOWMAN: "To Go Where No Man Has Gone Before"

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Abstract: IT-support for knowledge work should be designed to support and enhance the human interaction and knowledge sharing processes. The specific usage of web-based technology gives the possibilities of putting crucial, knowledge-related interaction on-line. For example, sharing bookmarks among knowledge workers seems to be a necessary and useful activity. Important and valuable bookmarks often mirror what kind of information and knowledge people are looking for and also what kind of forum they use to go to on the world wide web. In this work we have developed a prototype, KNOWMAN, which manages bookmarks on the world wide web. The prototype is designed as a user-friendly "pad-interface" in which bookmarks can be collaboratively collected, shared and further annotated and explored by other knowledge workers.

Introduction

As a knowledge worker you almost daily search for new information. The search process would involve both interaction with all the search engines on the web and interaction through communication with other people. There are several studies indicating that knowledge workers want to talk to each other in an intelligent conversation and not only interact with documents (Carstensen, & Sørensen, 1997; Carstensen & Snis, 1999; Magnusson et al, 1999). Other studies show that searching the web means in many ways to "reinvent the wheel" as individual knowledge workers search and collect the same information, without knowing each other's collections. What was found more specifically in Magnusson et al (1999) was that knowledge workers express a wish for possibilities to benefit from each other's experiences in the daily work practice. Such possibilities would assist in their often short term need for timely information without having to spend unnecessary overhead retrieving and compiling information. The knowledge work settings provided in previous studies reveal that important hyperlinks were used in quite a common manner: i) to learn about a specific topic, ii) to solve a specific problem, iii) to interact with other people and forums. This result points to the fact that the search activity is very important but at the same time very time-consuming and is made redundant among a group of co-workers (Magnusson et al, 1999; Snis, 2000) When considering IT-support in such circumstances many organisations implement huge systems, normally called knowledge management systems, that has a variety of groupware functionality offered to its users. Due to its complexity, one such "over-all" system, we argue, should not be considered. The successfulness of such system is quite the same as zero, as the individual knowledge worker does not want to add knowledge into such systems if not the answer to the question "What's in it for me?" has been answered "A lot!" quite many times. Instead we believe upon a design of a smaller application providing a subset of the functionality, which facilitates a process with user interaction, step-wise refinement, and effective management of knowledge in one single tool. Related work of Carstensen & Snis (1999) has further addressed what requirements common knowledge repositories, based on advanced information technological mechanisms like document archives, hypermedia spaces and other forms of shared repositories, further should fulfil. More specifically, the work of Dieberger (1999) has addressed the issue of designing for social navigation.

The Design of KNOWMAN

In order to support the direct interaction among knowledge workers our design idea is built upon the assumption that people want to talk to each other. This requirement was also an important one that was identified in our previous field studies. More specifically this is supported in the prototype by signatures and email-lists that can be added to the bookmark collection. The bookmark repository in KNOWMAN can not continuously be filled and maintained manually by the individual knowledge worker. Instead, there is a design idea aiming at self-evident, on-the-fly acquisition of bookmarks. The automated and simplistic way of collecting bookmarks "on-the-fly" is supported by carefully designed co-operative user interfaces applying easy-to-use principles. All the information collected is stored in a database, from which flexible reports can be generated. Browsing facilities are available through the dynamic catalogue structure, that can be further explored as the categories and types are generated from the database as well. The graphical design and the hypertext links of a web page make it easy to create an appealing forum for communicating complex information to a group and also get feedback comments.

KNOWMAN is built on a platform based on Microsoft IIS and the most common scripting languages such as ASP, dhtml and JavaScript. The information is stored in an MS Access database and is retrieved and stored by simple SQL strings. To be able to use KNOWMAN from a user perspective the only thing that is needed is a standard browser. From this perspective KNOWMAN is divided into two parts, one *contributor* part and one *consumer* part.

The Use of KNOWMAN

To be able to contribute to the application in an easy way the user has the option to access KNOWMAN by one click. To be able to do this we use a feature in the browser called Personal Toolbar (Netscape Communicator) or Links Toolbar (Internet Explorer) that allows us to add a button to the browser interface, which when pressed, opens a JavaScript browser popup window with a html-form. The form consists of six fields, where the first two fields are populated by the JavaScript and show the name of the page and the URL, which both are editable as well. The next pair of fields are two dropdown menus, populated by the database, with the functionality of categorising the URL (category and type). A comment field and a signature field, which are populated by a cookie, is the last set of entry fields in the form. A cookie populates the signature field, which is set the first time the user enters KNOWMAN. The signature is stored together with the user e-mail address for contact use.

As a consumer of information the user enters the KNOWMAN webpage and is confronted with different categories and types from where the user can browse and order URL:s. When the URL:s are listed the consumer has three options: click on the link, view comments about the link or add comments to the link.

Beyond being an excellent tool to ensure implementation of knowledge sharing processes this application serves as an important tool in the daily work of groups of people. One important issue is that we do argue for personal and contact information such as names, signatures and email information put into the database. The application provides a pop-up window in which to add URL:s, the personal information and annotating comments about the URL. There is a flexible reporting with collaborative annotation process and commenting capabilities. Annotating certain bookmarks is valuable knowledge that can be further explored by people who have never been at the URL before.

Conclusion and Future Work

We think that using KNOWMAN helps strengthening the feeling of identity among the group members. It facilitates interpretation of information for a knowledge creating process to take place. The individual efforts of searching the same information will not be made redundant. People and URL information is collected into a common workspace while the tool is built upon a quick and easy use. The next productive steps forward would be to implement the prototype and start investigating for developing the prototype further. Our plan is to evaluate its use in one of the organisations in which the idea and requirements are derived from and to use these evaluation scenarios as input for more detailed design work.

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University Strategic Plan, Goals and Mission: Guides for Transforming the Academy with Web-based Programs

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Abstract: Strategic planning for distributed learning at the University of Central Florida involves cooperation and teaming by the central administrative units and the five colleges. UCF has institutionalized distributed learning through an advanced technical infrastructure, administrative support and leadership, systematic faculty development, learner support, and ongoing assessment. The development and implementation of the university's Strategic Plan has helped the institution deliver courses and degree programs, provide student services, and support faculty development to enable faculty to use the Web as an instructional tool and platform for learner-centered instruction.

Background

The University of Central Florida is a rapidly growing institution of approximately 32,000 students projected to reach 45-50,000 by the year 2010. UCF's metropolitan setting in Orlando, Florida, is also one of the fastest-growing regions in the nation as a center for high technology and space-related industrial development. The university's student population growth has exceeded institutional ability to build classrooms and offices for faculty. UCF is preparing faculty to teach fully and partially Web-based and Internet-enhanced courses in ways that support and follow the university's goals, mission, and strategic plan. UCF is using distributed learning strategies to manage rapid student body growth and at the same time maintain quality instructional programs.

Strategic Planning

The 1996 UCF Strategic Plan is an ongoing, dynamic, evolving, and changing document that guides decision-making at all levels. The plan emphasizes that students are UCF's first priority—their education, learning, and human growth. New strategic endeavors and directions are encouraged to achieve the mission of the university by meeting the needs of a diverse student body. Embedded in the Strategic Plan is the university's enthusiasm to employ advanced information technology resources and services to accomplish its strategic mission. The ultimate goal is to transform teaching and learning across the institution.

Distributed Learning Modalities

The distributed learning modalities that UCF employ for course delivery are:

- the World Wide Web
- interactive two-way television
- videotape.

The World Wide Web is UCF's primary focus to deliver courses and degree programs and to provide access for students throughout the university's service area, the state, and the nation. Fully Web-based (**W**) courses utilize the

Web for instruction with no required face-to-face class meetings. Mixed-mode (**M**) courses employ face-to-face time in the classroom and Web-based instruction that reduces seat time. Other courses (**E**) are enhanced with the Web or other electronic media-based materials, but do not reduce seat time. Interactive live two-way television (**T**) increases student access to courses at eight sites, including the UCF area campuses and attendance centers. Videotape (**V, F**) with Internet enhancement delivers primarily undergraduate and graduate degrees in engineering.

The growth in distributed learning courses began in Fall semester 1996 with 9 course sections enrolling 125 students and progressed to 385 course sections enrolling 8,191 students during the Fall 1999 semester.

Faculty Development

A systematic faculty development program for on-line teaching is supported at the institutional level. Departments, with the approval of their college, submit proposals to the Center for Distributed Learning for development of courses, degree and certificate programs for on-line development. Grants for course release or dual compensation are awarded for faculty development and course conversion and development. Faculty then participate in an award-winning "course", *IDL 6543--Interactive Distributed Learning for Technology-Mediated Course Delivery*, developed and delivered by Course Development & Web Services. The purpose is to help faculty succeed as they plan, design, develop, and teach on-line or media-enhanced courses and programs. Course Development & Web Services provide full-time instructional designers, programmers, software engineers, and digital media specialists to support the faculty development and course development processes. Approximately 200 faculty have been prepared to teach on-line courses and mentor other faculty learning to teach on-line courses.

Learner Support

Support for on-line learners is provided by the same units throughout the university that provide support for learners on campus. Distant student support is coordinated and monitored by the Center for Distributed Learning, the administrative unit of the UCF Virtual Campus. The Center works with staff from the branch campuses, admissions, registrar, library, health center, orientation, and advising offices to ensure that distant students have access to the same services as students on campus. Course Development & Web Services developed a learner support CD-ROM, *The Pegasus Disk*, which includes learner readiness assessments, tutorials, university information and services, software and plug-ins needed by on-line learners. Other technical assistance is available almost 24 hours a day.

Strategic Organization

UCF is organized to support distributed learning program development and the use of technology to enhance operational excellence. Two Academic Affairs divisions support the distributed learning initiative at UCF. Information resource units including Course Development & Web Services are in the Information Technologies and Resources division. The Center for Distributed Learning and other units are in the Academic Programs division.

Impact Evaluation

Since 1996 UCF has collected data on the impact of its distributed learning initiative. Support for evaluation has resulted in a coordinated approach to collecting data about student and faculty demographics, growth in enrollment and sections, student and faculty perceptions to teaching and learning on-line, and problems encountered while teaching and learning in the on-line environment. These evaluation data are used to target improvements in faculty development, learner support, and technical support needed by faculty and students.

UCF website: http://www.ucf.edu
Distributed Learning website: http://distrib.ucf.edu
Course Development & Web Services website: http://reach.ucf.edu/~coursdev
IDL 6543 **Faculty Development Workshop website:** http://reach.ucf.edu/~idl6543/

INQUIRUS META-SEARCH TOOL: AN EVALUATION

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Abstract: This paper reports selected results from a study evaluating the Inquirus Web meta-search tool developed by the NEC Research Institute (Lawrence & Giles, 1998). The study examined Inquirus: (1) *effectiveness* based on the impact of users' interactions on their information problem and information seeking stage, and (2) *usability* including screen layout and system capabilitiesfor users. Twenty-two (22) volunteer end-users searched Inquirus on their own personal information topics. We analyzed end-user pre and post-search questionnaires, and Inquirus search transaction logs. Findings include: (1) Inquirus was rated highly by users on usability measures, (2) users experienced different levels of shift/change in their information problem, information seeking, and personal knowledge due to their Inquirus interaction, and (3) search precision did not correlate with other user-based measures as some users experienced major changes/shifts in various user-based variables with a low precision search and vice versa. Implications for the evaluation of Web and IR systems are discussed.

INTRODUCTION

Web meta-search tools such as WebCrawler and Dogpile offer different features and services. Effective Web search tool performance is an important and growing challenge for Web designers and researchers. Most Web evaluation is based on information retrieval (IR) systems research and use the IR measures - precision and recall - with their inherent limitations (Gordon & Pathak, 1999; Saracevic, 1995). New evaluation techniques and measures for Web search tools are needed. This paper reports results from a study evaluating the Inquirus Web meta-search tool developed by the NEC Research Institute (Lawrence & Giles, 1998). We use Spink and Wilson's (1999) evaluation framwork that measures the impact of users' interactions on their information problem and different stages of their information seeking process. Users evaluate Web tools in the context of their information seeking and retrieving behaviors beyond precision and usability measures (Spink & Wilson, 1999). We examine Inquirus usability and the changes users' experience in their information problem and information seeking stages as a result of their Inquirus interaction.

Twenty-two end-users responded to a call for study participants willing to use a Web meta-search tool, sent out of the University of North Texas email system. The age of end-users was 44.5 (range = 24-72), including 9 females and 13 males. Before searching Inquirus each end-users was first briefed by a Research Assistant on the basic features of Inquirus. End-users searched Inquirus on their own information problem in the Web searching lab for a maximum of two hours. Twenty-two end users' Inquirus interactions were analyzed using: a range of standard usability measures, precision measure, and impact measures on users' shifts and changes in their information problem and information seeking stages before and after their search.

RESULTS

End-User Changes Due to Inquirus Interaction

Change in Information Problem Stage

Five (31%) end-users shifted at least 1 information problem stage, thirteen (50%) end-users stayed in the *same* information problem stage and four (19%) end-users shifted to a *previous* information problem stage.

Change in Information Seeking Stage

Eleven (45%) users shifted at least 1 stage, seven (31%) users shifted to a *previous* information seeking stage and five (22%) users stayed in the *same* information seeking stage.

Change in Uncertainty Level

Seven (31%) users shifted 1 uncertainty level, four (19%) users shifted to a *previous* uncertainty level, and eleven (50%) users stayed at the *same* uncertainty level.

Different end-users experienced different levels of change in their their information problem, personal knowledge uncertainty level, or information seeking stage due to their Inquirus interaction. Search precision did not correlate with the user-based evaluation measures or users' perceptions of change in their information problem or information seeking stage. Some users' experience major changes in their information problem and information seeking stages but with low search precision and vice versa.

Preliminary data analysis indicates that Inquirus was fairly highly rated for a complex Web searching tool.

Table 1. Usability measures.

Usability Criteria	Mean User Ratings	Range - User Ratings
Frustration to Satisfaction	5.5	1 - 9
Difficult to Easy	6.3	3 - 9
Dull to Stimulating	5.5	1 - 9
Time to Learn		
Lengthy to Easy		
Speed	6.7	1 - 9
Response Time	6.9	1 - 9
Ease of Searching	7	4 - 9
Amount of Information Provided		
Inadequate to Adequate	7.5	2 - 9
Screen Arrangement		
Logical to Illogical	7.5	3 - 9
Screen Layout		
Inadequate to Adequate	7.1	4 - 9
Screen Terminology		
Not Helpful to Helpful	6.5	2 - 9
Messages	6.2	2 - 9
Overall Reaction to Inquirus	5.9	2 - 9

Further papers will provide a more detailed report of study evaluation approach and results.

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Utilizing North Dakota's Two-way Interactive Television Networks

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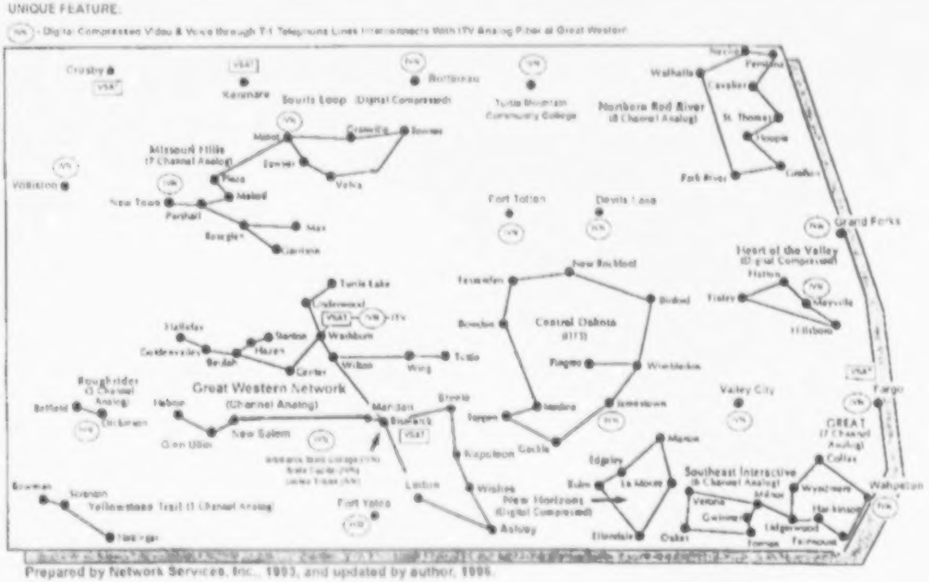
By combining the North Dakota Educational Telecommunications Council grants, state block-grant restructuring funds, and regional vocational state entitlements, a number of telephone line-based, two-way interactive networks were established from 1990 to 1992. In 1994, over 30 percent of high schools had access to instruction via two-way interactive television. A new digital T-1 network and a wide-area microwave network started operating by offering high school courses in the fall of 1994. Six high schools have been added since 1994. The principal objective of these networks has been to give high school students curricular choices that would not otherwise be available due to limited faculty, gaps in expertise, or insufficient enrollment.

High school video technology varies from voice-activated T-1 compressed video to switch DS-3 digital; however, most high schools utilize analog fiber for their two-way, interactive television networks. Sixteen of these high schools have their analog fiber network connected to the university's digital T-1 network. North Dakota's University Systems (two-way) Interactive Video Network (IVN) is a T-1 digital compressed telephone routing system that connects the state's eleven colleges and universities, five Native American community colleges, the state capitol in Bismarck, and several high school networks.

The primary purpose for university/secondary school connections is to provide staff development opportunities for teachers and school administrators. Consequently, the lines are often fully scheduled on late afternoons, evenings, and many weekends. As an example, a network of 22 high schools has an analog, fiber-optic classroom installed adjacent to a university T-1 classroom at Bismarck State College. However, it was purposely not connected to the university system so this local postsecondary institution could concentrate on meeting regional school and community needs without being encumbered by the university system's statewide scheduling environment. The system is known as the Great Western Network since the 1994 reorganization of three area networks that surround the state's capitol city, one of which was the first to operate in the state during the 1989-1990 term. (Five more schools were added in the fall of 1996.) The network is managed by one coordinator responsible to the consortium-governing board, whose members are school administrators.


UNIQUE FEATURE:
IVN - Digital Compressed Video & Voice through T-1 Telephone Lines Interconnects With ITV Analog Fiber at Great Western
Crosby
VSAT
Kenmare
Bottineau
Souris Loop (Digital Compressed)
Turtle Mountain Community College
Northern Red River (8 Channel Analog)
Neche
Pembina
Walhalla
Cavalier
St. Thomas
Hoople
Park River
Grafton
Missouri Hills (7 Channel Analog)
Minot
Glenburn
Sawyer
Velva
Williston
Plaza
Makoti
New Town
Parshall
Max
Roseglen
Garrison
Fort Totten
Devils Lake
Grand Forks
Heart of the Valley (Digital Compressed)
Hatton
Finley
Mayville
Hillsboro
New Rockford
Fessenden
Bowdon
Central Dakota (ITS)
Pingree
Wimbledon
Turtle Lake
Underwood
ITV
Washburn
Halliday
Stanton
Hazen
Golden Valley
Beulah
Center
Wilton
Wing
Tuttle
Great Western Network (Channel Analog)
Roughrider (3 Channel Analog)
Belfield
Dickinson
Hebron
Glen Ullin
New Salem
Mandan
Bismarck
Steele
Tappen
Medina
Jamestown
Gackle
Napoleon
Valley City
Fargo
GREAT (7 Channel Analog)
Colfax
Marion
Edgeley
Kulm
La Moure
New Horizons (Digital Compressed)
Ellendale
Southeast Interactive (6 Channel Analog)
Verona
Milnor
Wyndmere
Gwinner
Oakes
Forman
Lidgerwood
Hankinson
Fairmount
Wahpeton
Bowman
Scranton
Yellowstone Trail (3 Channel Analog)
Fort Yates
Linton
Wishek
Ashley
Hettinger

Prepared by Network Services, Inc., 1993, and updated by author, 1996.

The Educational Telecommunication Council initially provided funds to help pay for development and construction of three separate two-way interactive television networks. Then, during subsequent requests for proposal cycles, the Council fully funded the costs for connecting clusters in the Bismarck and Minot areas.

BEST COPY AVAILABLE

This included funding the costs of moving and installing an entire studio from a high school that had closed to the nearby Bismarck State College's Vocational Education facility, 50 miles away. This Bismarck area cluster combination was named the Great Western Network and is headquartered at Washburn. The other development was in the north-central part of the state around the city of Minot during the 1994-1995 school year. A telephone company had helped the Council in funding a DS-3 digital network in 1990.
The Council helped fund connections to a neighboring analog, fiber-optic network. Twelve schools now belong to this wider-area network. The Minot School District has two classrooms, one of each technological type to serve as the connection point between these two systems. High school usage is increasing to the extent that Garrison High School, a member of this Minot connection, constructed a second classroom without using grant funds from the Educational Telecommunications Council. The Northwest VSAT Network connects Kenmare, Crosby and Washburn to NDSU and any other site in the world with VSAT-to-satellite conveyance.

Two other regional interactive television networks were developed through the area vocational centers that serve as the pivotal point for the cooperation between the regular high schools. One is in the northeast part of the state where two rural counties are cooperating in conjunction with the Grafton Area Vocational Center. The four high schools in the Heart-of-the-Valley cluster form an IVN system connected to Mayville State University. The Oakes Vocational Center - cooperating with five area high schools - and the Wahpeton Vocational Center - cooperating with six area high schools - combined their two networks in 1993 to create the GREAT Interactive Television Network. Wahpeton State College of Science, primarily a postsecondary vocational school for eastern North Dakota, offers college courses to high school students in these rural networks. The college campus is connected to the statewide two-way Interactive Video Network (IVN), but the GREAT Network studio is not connected to IVN.

Broadcast telecommunication services

North Dakota has three satellite uplink systems funded, for the most part, by various federal funding agencies and made possible by federal legislation. University-based transportation and aeronautical programs have a regional support base in the nation. The third uplink, installed with congressional funds through the U.S. Department of Agriculture, is Prairie Satellite Network. This network was completed in 1994 and provided satellite dishes to 70 of the 190 secondary school districts. Two satellite studios are used to broadcast programs developed by educators and/or entrepreneurs. In addition, this public telecommunication group offers school television services over its statewide microwave system. The services are available to any school district or individual (adult) because they are aired over the Public Broadcasting System (PBS) network during the daytime.

Recent studies about the utilization of these systems

Two graduate students prepared separate studies about the utilization of these interactive television systems. Placek (1999) illustrated how rural students have greater access to be involved in vocational education courses. Strasser (1999) provided a case as to establish essential instructional components necessary for effective interaction environment via these two-way interactive televisions systems.

Placek concluded that evidence strongly suggests that distance education via these networks is an effective means for delivering instruction. She found substantial evidence that North Dakota high school students to have greater access in vocational/technical classes because rural high school student participation increased from seven in 1991 to an aggregate total of 1,158 in 1996. This increase is among small rural schools not previously involved in such programs. The small schools constitute about a fifth of the states total high school (9-12) total enrollment of approximately 37,000. North Dakota's entire population is about 630,000.

Strasser developed a profile from a literature review and had a panel of experts validate it as a tool to provide insight was to what teachers using these systems deem effective. The items found to be extremely important by the majority of the population involved were keeping the total class size at or below 25, the ability to hear and see students clearly, having an effective site facilitator available at receiving sites, having telephone access, and a sound student behavior system whereby forms are provided by students and parents outlining expectations and consequences. Common school calendar and common daily schedule were important factors The factors he found least important where utilizing different cameras and camera angles throughout the class period.

The faculty at North Dakota have utilized these systems extensively since 1990. They are starting the third two-year cycle in cooperation with their competitors at the University of North Dakota. Approximately 100 students have received advanced degrees in educational administration during the past decade while utilizing these networks (Stammen, Van Berkum, & Nygren (1988). E-mail and the web page systems CourseInfo are used extensively to supplement the instruction delivered via the statewide interactive television networks. The cooperative program with UND utilize one or two Saturdays per course to meet in a regular classroom environment at a location near to most students.

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IT Support for Coordination and Collaboration in Health Care

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Introduction

This paper reflects some results of our ongoing research about information technology support of the coordination and collaboration problems in the Health Care area. The information technology has to be included in work practice and may also invite the patient to participate in the information process and share the information. How can the patient, who is the object of care, get more involved upon her care process?

Our research are related to both the medical field concerning the development of palliative care and to IT researches about electronic patient record (EPR) or information technology use in health care. The hospital and primary care organizations in our region have during the latest years developed manual routines about palliative care administration of medical information, together with the communities of the region and their social services organization (Palmberg, 1998). Many organizations both in Sweden and other countries work with the development of routines for care and its administration (Fakhoury & McCarthy, 1998). Today many health organizations use EPR. In our region primary care organizations use an EPR system and the hospital organization has just started implementing a different kind of EPR system. Some interesting research is made in IT use in medical practice (Hanseth and Lundberg, 1999). Berg (1999) discusses how information technologies matter for accumulating and coordinating medical information. As a theoretical framework we use actor-network theory (ANT) and Computer supported Collaborative Work (CSCW). ANT recognizes that establishing and changing a social order relies on tight interplay between social and technical means. The problems it discusses are directly relevant to the aims and hopes of CSCW: the design of systems that fits work practices better than traditionally designed systems, and that enhances workers' competencies and responsibilities.

The Study

Palliative patients, who are at the end of their lives, very often have a wish to stay at home during their care and this desire involves different kinds of care and service organizations in the treatment. This patient category is mostly between 50 to 80 years old and in Sweden they are 95% cancer patients. Is this wish to stay at home unique? No, a similar group of patients are those with different kinds of handicap who also want to be at home or their parents want them to be at home. Families with handicapped children are entitled to be supported in different ways (Stegberg, 1998).

Our method is based on interviews with representative personal from different organizations and relatives of patients. In our case we have four different actors connected to the collaboration. Two of these actors, the Palliative Team and Primary Care Service, are responsible for the care of the patient and one actor, Home Care Service, has more liability for the service and the daily treatment of the patient. Today the cooperation is problematic with many different actors. At home today the patient has a copy of his or her own paper medical record, named – My Medical record. This medical record is used for the coordination, collaboration and documentation of the work between all-different caretakers and service organizations, but also for the patient's or relative's comments, and this is the fourth actor. "My medical record" is from the beginning an extract from the hospital original medical record, new activities and treatments must be documented in the paper – My medical record. Here we face one problem, everything you want to document you have to write down twice, both in the patients original medical record that belong to the involved caretaker, and in the patients own – My medical record. Every caretaker's organization has its own medical record. This gives another problem. How shall the caretakers inform each other about activities and results that they have written in - My medical record or written in their own medical record for the patient? A third problem is that the caretakers are not in the right atmosphere or have time enough for a sufficient documentation when they are visiting the patient at home. Those problems give a discrepancy between different medical records' content about the case. A fourth problem is how the comments from the patient or the relatives shall be documented in every other medical record that is involved in the treatment. A traditional electronic patient record (EPR) cannot coordinate these circumstances, with many different actors involved, with different responsibilities and work practice, and together with the patient in her home. The patient in this case is the owner of her own medical record. The patient take her -My medical record -with her when she visits a caretakers organization. It is very important to most of the palliative patients to have their own medical records. It is then easier to show and talk to other people about it or to read their own medical record at any time they want, this gives the patient a possibility to feel safety.

Conclusions

One of the supreme goals in palliative care is that the patient and his or her relatives would be confident in the care situation. From the palliative patient's point of view it is important to feel that the different caretakers act united even when they represent different organizations. To share all relevant medical information concerning a certain patient will optimize the conditions for good care in the patient's home and promote the patients and the relatives' confidence.

Our research is about how to use the web technology for coordination, collaboration and documentation, when many different actors are involved in the care of one patient, and when the patients or relatives own experiences during the care process are important to document. All actors have to do their inscriptions in the same artifact - My Medical record. The artifact - My Medical record - is itself an actor for coordination and collaboration. Our patients are not in the right age to use computers or in the mood to learn or to have a computer at home. They have more important things to think about than computers. Which technique shall we use? We have suggested that the patient still have her medical record on paper. It is easy to use and everybody can handle it. The patients or the relatives own documented experiences are written by hand on paper and this information is useful for other actors too. Instead of rewriting it on the computer we fax it to the common medical record and complement the Intranet-EPR on the web. The common My Medical record is a web-based Intranet medical record, where all actors have the possibilities to read and write inscriptions, and of course they have to sign their addition in the medical record. When one actor has written some documentation about the case at her office, it shall be easy to send a fax to the patient to add to the patients own paper medical record. The information on the web has a sign that indicates if the information has been sent to the patient. This will help coordination and avoid inconsistency between different sources. When caretakers are at home with the patient it must be possible to connect a portable computer to the Intranet. In our research we also do experiments with Palm computer organizer as the portable computer for all actors.

Our ongoing research involves researchers from the hospital and the university in our region, it also involves a lot of students in different activities. The system shall be developed and test implemented at all involved organizations during the spring 2001 and after that we shall evaluate, both the technique and how the system supports collaboration between different actors.

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Students, Learning, and Technology: The Importance of Interaction

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Abstract: This short paper reports on two outcomes from an ongoing evaluation of the infusion of technology into a large, multi-section, undergraduate education course at The University of Memphis a large urban university. The two outcomes address how the students' (N = 294) assessed their own learning and how the students' rated their instructors. With both outcomes, student-student and faculty-student interactions were the important variables.

Only through assessment can we begin to focus on what is actually being accomplished with the infusion of technology in higher education classrooms. The question of whether or not to infuse technology is no longer the important issue. It is mandatory. As Dolence and Norris (1995, p. 2) have aptly explained in their book, "Transforming Higher Education: A Vision for Learning in the 21st Century," society is undergoing a fundamental transformation from the Industrial Age to the Information Age and students simply must be prepared.

At the same time, technology cannot totally replace the need for instruction and instructors. Students crave personal interaction and guidance (Carr, 2000). After all, education is basically a human endeavor (Theobald, 1997). As the past president of EDUCOM Robert Heterich stated, classrooms are highly personal, human-mediated environments (Noble, 1997, p. 6).

The purpose of this paper is to address "what happens" as technology is infused in a large undergraduate education course (N = 294), taught in 11 sections by different faculty. The course is a human development course required of all pre-service teachers, nurses, and other health care professionals. Prior to the 1999 fall semester, the course was a traditional lecture-based, teacher-centered course. Beginning with the 1999 fall semester, the use of technology was infused throughout the course.

The sample size for the first semester evaluation was 207 students (70% response rate), primarily sophomores and juniors. The gender composition was 33 men and 174 women. The racial/ethnic composition was: 71 African-American, 121 white, 1 Hispanic, 14 other. The context for data analysis was multiple regression. The variables for the study included the: amount and quality of student-to-student interaction; amount and quality of student/faculty interaction; overall experience using technology; number of times the instructor e-mailed the student during the semester; amount of time the instructor used the available technology in the class; general rating of the instructor; student interest in using the Internet for schoolwork; amount of time the student used technology during the semester for schoolwork; and amount of problems the student had in using technology.

The first analysis addressed how the students' assessed their own learning. The dependent variable was called LEARN and consisted of three questions which addressed the amount of student learning, their motivation to learn and their familiarity with computers (Cronbach alpha = .82). The regression was significant, $F(6,188) = 16.59$, $p < .001$ and the variables accounted for 35% of the variance in LEARN. The significant predictors of LEARN, as determined by the standardized beta weights, consisted of student/faculty interaction ($b = .20$, $p = .009$), student-to-student interaction ($b = .293$, $p < .001$), the general rating of their instructor ($b = .159$, $p = .016$), and student interest in using the Internet for schoolwork ($b = .174$, $p = .015$). What the first analysis indicates is that as the quantity and quality of both the student/faculty and student-to-student interaction increased, the students' assessment of their own learning (LEARN) increased. In turn, as the students' assessment of their own learning increased, so did the general rating of their instructor and the students' interest in using the Internet for schoolwork.

The second analysis addressed, the students' general ratings of their instructor. The dependent variable was called INSTRUCT and consisted of a single question rating their instructor. In this analysis, LEARN became part of the independent measures. The regression was significant, $F(5,194) = 15.46$, $p < .001$, and the variables accounted for 29% of the variance in INSTRUCT. The significant predictors of INSTRUCT, as determined by the standardized beta weights, consisted of the number of times the instructor e-mailed the students during the semester ($b = .180$, $p = .015$), and the amount of time the instructor used the available technology in the class ($b = .220$, $p = .001$). What the second analysis indicates is that as the number of times the instructor e-mailed the students during the semester increased and the amount of time the instructor used the available technology in the class increased, the students' assessment of them increased.

It is important to note that the variables used in the study accounted for a small amount of the total variance in either LEARN or INSTRUCT. Since there has been very little data reported in this area and we know that much goes into student learning as well as evaluation of instruction, it is hard to say whether or not the amount of variance accounted for is small or indeed quite large.

What does this study mean? First, the results indicate that students do draw a distinction between student-to-student interaction and student/faculty interaction. The two types of interaction are different and serve different purposes. Classroom research has generally focused on the importance of student-to-student interaction, the incorporation of cooperative/collaborative learning activities and addressing the different learning styles of students. While student/faculty interaction has been shown to be an important factor in retention, scant research has been done to address the interaction in terms of student learning.

Second, the results from this study indicate that student/faculty interaction is just as important a factor in student learning as student-to-student interaction. It is not enough to just create an on-line discussion group for students. Students need feedback and guidance from instructors. Student/faculty interaction has traditionally meant time spent on teacher-directed activities inside the classroom and to a lesser extent, due to its time consuming nature, outside the classroom. With the infusion of technology the distance between the student and the faculty member is lessened and the dividing line between inside and outside the classroom becomes blurred in a very short period of time. In fact, faculty who received higher evaluations e-mailed students more times and used the available technology more often in their class. In turn, by increasing the amount of interaction via technology, students' learning increased.

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Designing and Deploying a Web Application Programming Course in an Information Systems Curriculum

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Abstract: The sudden emergence of e-commerce and web deployed database applications on the Internet and on corporate intranets over the last two years has created an ever increasing demand for Web development programmer analysts, a need that has outstripped many educational institutions' output of computing professionals in this area. This paper describes the planning and resources required to institute a new course in Web application development and programming in information system curriculums at two mid-size universities. The primary objective of the course is to learn how to develop dynamic Web sites that interact with a backend database. In the class the students worked with all components, from browser to server, including the building of the database and dealing with operating system and network requirements. Team projects provided the culminating experience of constructing e-commerce sites with a database backend.

Course Development for Web Application Programming

Forrester Research Inc. estimated that consumers spent about $4 billion shopping on the Internet between Thanksgiving and New Years Day last year. Goldman Sachs Investment Research estimated that revenue from e-commerce would grow from $114 billion in 1999 to $1.5 trillion in 2004. The sudden emergence of e-commerce and web deployed database applications on the Internet and on corporate intranets over the last two years has created an increasing demand for Web development programmer analysts, a need that has outstripped educational institutions' output of computing professionals in this area. It would seem that a key role for educational institutions is to provide Web-ready professionals who have a structured and analytical approach based on the principles of object programming and solid database modeling and design.

Understandably, educating computing professionals has it own problems. The pace of development in the commercial Internet, where huge investments of capital and programmer power constantly generate new methods and technology, has often exceeded education's ability to respond, especially in light of the curriculum lead-time required for semester scheduling and the more limited technology resources of most educational institutions. Computer educators are faced with a plethora of new languages, scripting dialects, and application development environments that must interact with constantly evolving database engines and network systems.

Course Curriculum Planning

This paper describes the planning and resources required to institute a new course in Web application development and programming in information system curriculums at two mid-size universities located in the mid-west and south.

At both schools the integration of the Internet into academia had followed a similar evolution. Some faculty had progressed from using existing Internet resources in classes to creating their own course Web sites, largely with static web pages, while students, both in computing related majors and non-computing majors, had the opportunity to learn how to create personal Web pages. All students were provided with web server space for their pages, but it is interesting to note that few computing majors created personal Web sites as they appeared to approach computing as an academic activity rather than a creative or social outlet. This lack of Web page development experience among computing majors meant that despite their experience in formal programming languages and systems analysis, any new Web course would have to start with Web page basics.

The motivation to create the course came from several directions. Two years ago students had expressed an interest in learning Java, which was quickly added to the curriculums as an alternate programming language elective. There were little additional resources needed for these new courses as the instructors did not incorporate Web applications into the topics and the Java classes reflected a formal, programming class similar in structure to the required C++ courses. Also during this time Visual Basic escalated its status to an alternative to COBOL, while the client/server and advanced database courses started dipping into Web applications.

However, at one school, it was the evolving needs of the senior CIS capstone course that provided the final impetus. In this one-semester course, a student team, consisting primarily of graduating seniors, is assigned to a real-world project where they analyze, design, and implement a computing solution for a regional business, community organization, or educational unit. Over the past year there have been several projects that required a Web interface to a database backend, but in each instance the learning curve for Web page development increased the teams' startup time and tended to reduce their analysis and design effectiveness. The combination of unknown scripting languages and the browser/server mix of coding and database interaction inherent to dynamic Web pages had proven to be a summer highway construction zone, hard to traverse and very slow going. The traditional separate language and database courses were not adequately preparing students for this new integrated approach to transaction processing.

Regional corporate advisory boards and industry recruiters who needed interns and employees with Web development skills provided further encouragement. Thus was born the new courses, not as an offshoot of the latest fad, but as a response to the real needs of students and employers. Now the selection of course topics, application of pedagogic method, and the planning the course delivery logistics began.

The primary objective of the course is to learn how to develop dynamic Web sites that interact with a backend database. The course focuses on designing Active Server Pages with lesser attention to DHTML and client-side editing. Due to the prevalence of Visual Basic in the existing curriculums and the availability of Microsoft software at both schools, VBScript was chosen as the primary scripting language, with the inclusion of some JavaScript on the client-side. The primary browser is Microsoft Internet Explorer, however, students are required to test their pages in both Internet Explorer and Netscape, and to design whenever possible with browser compatibility in mind.

Course Technical Needs and Implementation

In the class the students would work with all the components, from browser to server, including the building of the database and dealing with operating system and network requirements. This meant that they would have to have electronic access to a Web server that had the proper permissions for ASP pages and database activity. Due to security and performance issues this was not possible on the universities' regular student Web server space, as they did not permit ASP execution and they didn't want students experimenting with scripts in their zone. For this reason and to maximize course flexibility and independence, the instructors installed NT4.0 and Internet Information Server (IIS4.0) on Pentium servers whose only purpose is to serve as Web server space for student projects in upper level computing classes. Visual InterDev was selected as the development environment editing tool. On campus the students can connect directly to the class IIS4.0 server via Windows Explorer and from off-campus they can FTP into their Web folder.

When the course was originally planned it was determined that Advanced Database Design and Visual Basic would be required so as to maximize the application projects, but after some student cajolery there was waiving of prerequisites by instructor consent. As a result there was a mixed background of student knowledge ranging from zero to one course in VB, Java, HTML, and the Advanced Database design course. Less than 10% of the class had any prior web programming experience.

In the first half of the semester all assignments were individual so as to build a solid base of common skills, but group projects predominated in the second half of the course in order to practice collaborative techniques, build communication skills, and design more sophisticated applications. Team projects provided the culminating experience of constructing e-commerce sites with a database backend.

An WWW-based Supporting System Realizing Cooperative Environment for Classroom Teaching

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Abstract: In the educational domain, a popularization of computers and the Internet enables us to hold lectures using Web contents as a teaching material. We propose CACCE, Computer Aided Cooperative Classroom Environment, which is an WWW-based supporting system for a classroom teaching. CACCE consists of a teacher's browser and a student's browser, which are softwares made of a combination of an ordinary browser and a socket connection. These browsers communicate each other through the socket connection. CACCE enable us to do several useful things for holding a lecture. It is more suitable for classroom teaching than ordinary browsers.

Introduction

As the Internet has come into wide use, the World Wide Web(WWW) is swiftly becoming the greatest knowledge resource for everyone. Using computers in the classroom, teachers sometimes have to show the contents on a teacher's display to students or vice versa. In this paper, we propose CACCE, Computer Aided Cooperative Classroom Environment, which is an WWW-based software that allows a teacher to have control of his/her student's displays. CACCE runs on some kinds of PC which is running on Windows 95 or higher. This may be commonly introduced into schools.

Outline of CACCE

We have designed CACCE with considering the following assumption. Firstly, students are allocated one personal computer each during the class. Secondly, the PCs are connected to the Internet. Finally, students understand how to operate a mouse and to type characters from a keyboard. These assumptions may be commonly satisfied by the almost all classes which is held in a computer room.

Fig. 1 illustrates the outline of CACCE. It consists of a server-software and a client-software: a teacher's browser and a student's browser. Both browsers have the same function as an ordinary browser. A teacher's browser has a server socket, and a student's browser has a client socket. A teacher's browser always listens to a request to connect from student's browsers. Receiving the request, the teacher's browser makes a socket connection. These browsers can, hereafter, send and receive some commands of CACCE through the socket connection. No bitmap data is sent between these browsers, the only command is sent.

Features of CACCE

A teacher's browser and student's browsers work in cooperation with one another. CACCE is not only a tool that broadcasts the document shown on a teacher's browser, but also a cooperative environment.

Students' View

There are two main features of CACCE in a student's view. The first is an automatic refreshment of student's browsers. When a teacher explains showing an WWW page, students listen to his/her explanation showing the same page on their browser. The teacher may, however, change a page unexpectedly, or forget telling a URL of a new page, then students lose the explained page. CACCE prepares a function displaying synchronously among a teacher's browser and student's ones.

The second feature of CACCE is that students can watch the teaching materials on their own pace. The synchronized displaying is useful for following a page of the materials. Students would probably like to rewind, however, the materials if they are not able to understand its contents or the explanation. A student's browser allows a student to show any page just like an ordinary browser. They consequently can read contents on their own pace.

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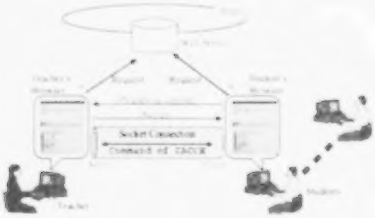

Figure 1: Outline of CACCE

Command	Direction
Display	T → S
Put a Cooperated Mark	T → S
Erase a Cooperated Mark	T → S
Send an Allowed List	T → S
Get a Shown Page	T → S
Tell a Shown Page	S → T

Figure 2: Main Commands of CACCE

Teacher's View

There are three main features of CACCE in a teacher's view. The first is a cooperated mark. A teacher points an explained area in the shown material in order to make his/her students easily understand. The cooperated mark is used in this situation.

The second feature of CACCE is a report of the WWW page shown by each student's browser. A student's browser can show any page, and sends a URL of the page shown on it to the teacher's browser at the same time. Then, a teacher can spy a page which each student shows. If many students show the previous page, s/he may interpret that as an evidence that his/her explanation is too fast. This feature can be used as one of the guidelines for teaching.

The third feature of CACCE is a function limiting a student's net surfing. Unrestrainedly being able to do net surfing, some students may watch a page which is irrelevant to the lecture. CACCE prepares a prevention for student's wrongdoing. It is classified into three degrees: spying the page which each student shows, limiting the page to the set of page registered by a teacher, and freezing student's browsers.

A Prototype System

We have developed a prototype system of CACCE in Delphi which is a kind of Pascal programming language. The system runs on Windows 95 or higher. Each browser consists of five modules: a displaying module, a socket module, a sending module, a receiving module, and a control module. The displaying module performs its duty as a ordinary browser, the others except the control module perform their duty on the socket connection. Therefore, CACCE is considered as an ordinary browser plus a module to manage the socket connection between browsers.

Messages sent between CACCE's browsers are made of pure texts divided by a comma. Each message consists of a header and some parameters, is distinguished by the header. Fig. 2 shows the main command of CACCE. For example, a teacher's browser sends a "Display" command through the socket connection in order to activate a synchronized displaying function. This command has a parameter to fill a URL. The student's browsers take out it, require its content from the Web server just like an ordinary browser.

Application to Classes

We have tested the system to connect among one teacher's browser and forty student's browsers. The PC's and the network in the classroom are slower then today's ordinary ones because they have been used since 4 years ago. We confirmed that each function of CACCE worked good and the response time for the synchronized displaying was a few seconds. There were, however, a few browsers which kept user waiting for about one minute to display the same page as the teacher's browser show, when the network traffic was jammed. We think this happening is not caused by the method to implement a synchronized displaying in CACCE because it does not always occur.

Conclusion

In this paper, we proposed CACCE which is an WWW-based supporting system for classroom teaching. It enables us to do several useful things for holding a lecture. We plan to improve the graphical user interface (GUI) and add more functions with which users can operate CACCE more easily and effectively. CACCE doesn't send teacher's voice or student's voice because we assume that the voice carry far without a network in a classroom. If CACCE has, however, a function to send it, we think that it becomes a supporting system for a distant lecture too.

Development of Collaborative Gathering Information System (CGIS) utilized by XML and Personalization

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Introduction

With the spread of Internet and development of digitization, our circumference is filled with various information resources. Most of such information resources grow up as existence to give an important clue for learning, business and many problems we have in life every day. In fact, some companies adopt Groupware and EIP(Enterprise Information Portal) in order to share and learn business intelligence between many employees. The purpose of this study is to develop a system of sharing network information resources and promoting collaborative learning. This system, Collaborative Gathering Information System (CGIS), integrates various network information resources to XML and has some functions to reuse information gathered. Furthermore, by utilizing filtering collaborative technology it can distribute useful information that met profile of users.

Basic Concept

The basic concept of this system resembles "Data Warehousing". This system is divided into two functions.

- A function to integrate in a common XML format while maintaining the structure of information gathering by this system
- As agent to personalize information and send a new notice to users

XML (eXtensible Markup Language) is Electronic Data Interchange format of next generation and succession language of prospective SGML.

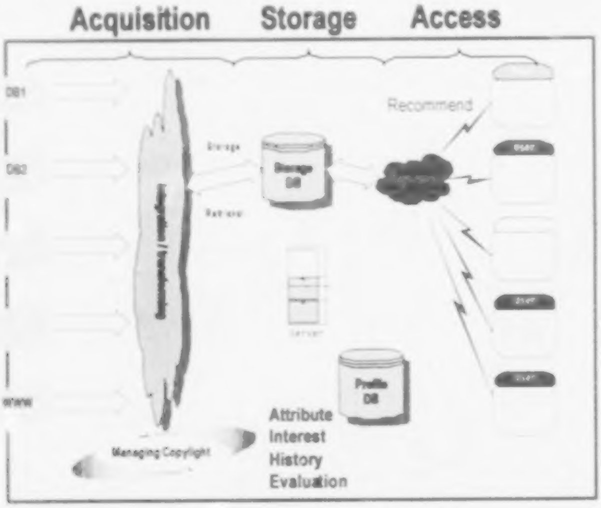

Table 1: Basic concept of CGIS

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User interface

This system has administrative (server) and user's (client) functions as follows. Major Administrative functions are to authenticate users, personalize user interface, analyze user access logs, and register channels (various information resources on networks). These take administrative function distributing information.

Main users functions are to inspect information gathered (And we can jump the Web site if the channel is Web resources on networks), edit their channels, and retrieve information. By utilizing XML we can retrieve information more effectively than by utilizing ordinal retrieval systems.

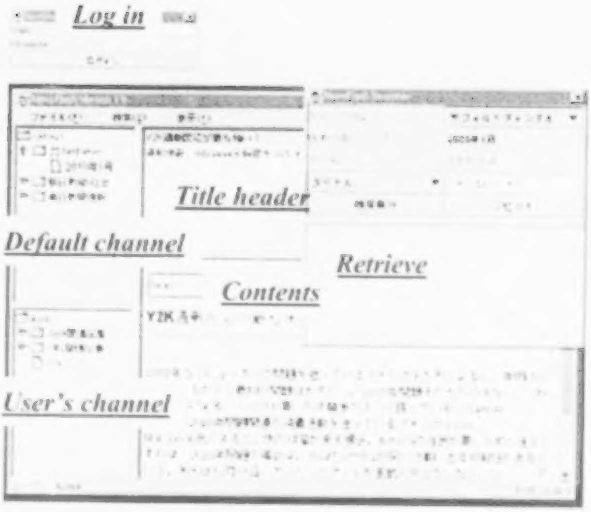

Table 2: User Interface of CGIS

Evaluation

We only enforce a simply experiment for usability evaluation at present. Many users pointed it out as follows. "When we gather information and data for various information resources on networks, it is hard to retrieve and share them because of the different in the use method and format of each information resources."

In this experiment most of users evaluate the case that used this system (CGIS) higher than not use it. We developed the prototype system utilized CGI Web technology last year, but this system used XML and Java is much faster than the prototype at a point of representation speed from the view of system's efficiency.

Conclusions

So far we have outlined the concept and function of CGIS that promote to share and learn information on networks. In Concluding, we guess that this system has high effectiveness as administrative tools for various information resources.

From this point we might go on to an evaluation of the effectiveness of using this from the statistical view (for example "recall ratio – relevance ratio") in future. The future direction of this study will be one that encompasses both "Information filtering method" and "Application study of system".

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Experiences from the Development and Use of Simulation Software for Complex Systems Education

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Abstract: In this paper, we present our lessons from the design and use of two educational software tools for teaching behavioral modeling to graduate students of digital art. The tools, PainterAnts and VLab, allow the experimentation and control of simulated ants that paint, or Braitenberg vehicle-like agents (Braitenberg 1984). To better address the target audience of digital art students, we have transcribed both systems in ways that would excite art students, that is, by finding graphical equivalents of behavior. This arrangement allows us to exploit the users' visual experience and motivation to manipulate and experiment with complex visual forms. Experience with using the systems reveals that the artists show a high motivation for experimenting with them, which is partly due to the fact that they tend to regard them as simple abstract art tools that may produce interesting complex forms. Our experience has identified several methodological and theoretical issues on educational system design that have been partly tackled and that merit extended study and research.

Introduction

Within the framework of a master in digital art, we have developed a set of educational tools for artificial life and the complexity sciences. These software tools constitute a laboratory curriculum that is used to supplement the theoretical courses on the subject and contain, among other things, an ant-based painting tool, called PainterAnts (Tzafestas 2000), and an educational tool for behavioral modeling, called VLab (Tzafestas & Prokopiou 2000). "PainterAnts" is a special-purpose ant population demo that tries to convey and teach regulation principles using graphical means. VLab allows the experimentation and control of simulated robotic agents that are Braitenberg vehicle-like, and its purpose is to make students familiar with simple behavioral modeling.

To better address the target audience of digital art students, we have transcribed both systems in ways that would excite art students, for example in Vlab we have introduced an additional behavioral parameter, the brush, used by the simulated agents to draw paint while moving around. This arrangement allows us to exploit the users' visual experience and motivation to manipulate and experiment with complex visual forms.

In a more general line of work, the education of artificial life with the aid of graphical tools allows us to put the user in the place of an external modeler that tries to understand the operation of a system by forming a model of the system. In this sense, our long-term objective is to study the relation between artificial worlds and the models that humans construct about them.

PainterAnts and VLab

The goal of "PainterAnts" (Tzafestas 2000) is to support teaching of regulation principles and their effects by studying patterns of color in space. These patterns are generated in a distributed way by a population of simulated agents, called painter ants. The painter ant model is inspired from the model of an ant that gathers food samples and brings them back home.

The goal of "VLab" (Tzafestas & Prokopiou 2000) is to support teaching of behavioral modeling by studying colored robotic paths in 2D space. These paths are generated by one or more simulated robots or Braitenberg-like "vehicles" (Braitenberg 1984), each one endowed with a programmable "brush" used to draw/paint on the environment while moving around.

Our observations on the users of the system and its potential for learning are presented in detail elsewhere (Tzafestas 2000) and involve issues such as experimentation with the aid of predefined protocols and special-purpose tools and user-directed methodologies.

On tools and design

An educational software tool has to encompass both general- and special- purpose functions. General-purpose functions are necessary to support education of the subject addressed (here, it is behavioral modeling in both cases), *independently of the target audience*. Special-purpose functions are necessary to respond to the particularities of the audience (here, it is a class of graduate students in digital art). For example in VLab, the vehicles behavior library and the simulator are reusable in any university-level class, independently of discipline, whereas the brush models and the visual experimentation protocols are specially designed for classes of art students. Of course, we expect to have a different balance of general-versus special- purpose functions for different education subjects and audiences. On the other hand, thoroughly special-purpose educational software tools for particular audiences and a given subject, work sometimes better, but they are rare. What is truly necessary, is a modular software methodology that will allow customization of given tools for different audiences. We expect to be able to tackle this issue after acquiring experience with particular educational software tools, adapted to different user classes.

Another issue is the need for involvement or participation of the user to the system operation, to ensure high motivation for learning. This can be done in a number of ways, such as an intrusive adventure game that addicts the user or an artistic creation tool that attracts a user who happens to be an artist. A methodology that invites participation in a particular educational tool is generally special-purpose for a given subject and audience. Such an approach that seeks to design participatory environments, has the special feature that teaching (teachers) and learning (students) are separate, and what actually connects the two is the software tool. It is the role of this tool to translate what the teacher says to what the student understands, and vice versa.

Education and learning, through participation or otherwise, is not enough. What we would like is to integrate a particular software-driven course to the general educational policy that applies to the target audience. Integration means that students should be able to use and reuse ideas and material in other contexts within their educational environment. In our case, we have observed that students are systematically importing images created with PainterAnts and VLab to other tools that they are using, namely standard tools, such as Adobe Photoshop and Macromedia Director, or home tools created in our laboratory. This is an indication that the particular educational tool has gained recognition among our students as a valid image creation and processing tool.

The latter observation also unravels a difficult issue, that of the objectiveness of education. What exactly do we expect students to learn ? Is learning something objective or something profoundly personal ? While we think it is impossible to give a general and definite answer to this question, we have fewer problems of such philosophical nature in our case, because education of artists relies precisely on personal acquisition and expression by each student, and only rarely on objective or systematic views, at least when imagery is involved.

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Surveillance Web-Camera Application

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Abstract: Web-Cameras have gained wide spread popularity for a variety of purposes. Most of the available applications use the snapshot approach, where the camera is mounted in a certain position and the field of view is fixed. This paper describes a Web-Cam application that allows remote users to control the Field of View (Zoom and Telephoto), the position of the camera (two degrees of freedom), and customize a surveillance program (capturing frequency, camera position, and response based on motion detection).

Technical Description

Figure 1 shows the user interface for controlling the camera. The smaller image at the top defines fine camera movements along with zoom and telephoto controls. The image at the bottom allows absolute movements of the viewing area. A maximum motion on the vertical axis is 40 degrees and on the horizontal axis is 100 degrees. The camera used is a Cannon VC-C1 connected to a PC capture card.

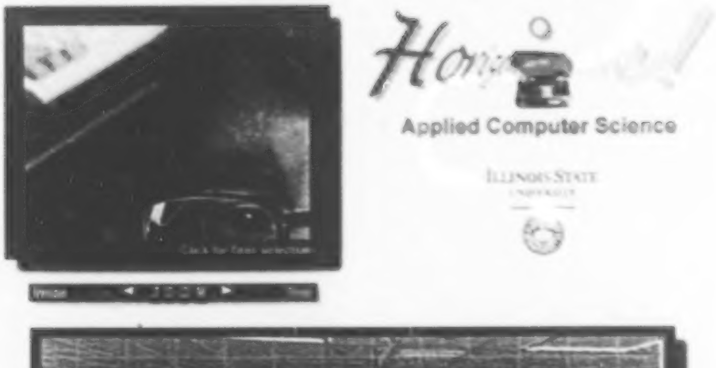

Figure 1: Web-camera User Interface

The surveillance control of the camera is done over the web using the Common Gateway Interface (CGI) interface on the server. The program transfers "live" still images captured at the user's request. The images are captured in a JPEG format. The program responds to user's request by updating their browser page with a newly captured image. Users can request camera adjustments including position, focus, and field of view by using the controls provided. Figure 2 depicts the architecture of the surveillance web-camera application.

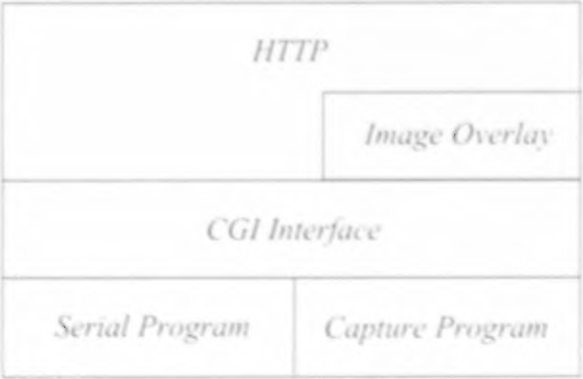

Figure 2: Architecture of Surveillance Web-Camera Application

The user interaction with the web-camera surveillance application consists of the following sequence of events:

1. Client requests camera view from the HTTPD Server.
2. Server passes control to the CGI module.
3. CGI calls serial program to position the camera.
4. CGI invokes the image capture program.
5. CGI invokes the image overlay program.
6. HTTPD Server transmits an updated image to the client.

Future Development

Currently, work is in progress to convert the web-camera surveillance application from CGI to Java. In order to integrate all of the functions into Java, a commercial library was purchased to provide serial port control and it is expected that this change will improve the camera responsiveness.

Acknowledgments

The authors wish to acknowledge the work done by Narottam Kumar and Scott Kiel during the implementation phase of the web-based project and Edward Jones for their sponsorship.

Creating a Collaborative Web-based Training Virtual Team

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Abstract. This article describes the process of forming a non-profit Manufacturing Education Program to create Web-based training curriculum and materials to help students prepare for Machining Level One certification under the standards of the National Institute of Machining Skills. The point is made that reviews of the literature fail to fully prepare developers for the full complexity of such a task, and the aspects of the project which became evident only after plunging fully into the midst of implementation are discussed. Special emphasis is placed on the necessity of ensuring diverse and cross-disciplinary competencies on the part of the development team.

Introduction

The Internet opens up entirely new channels for the development and distribution of online learning experiences, which can serve as prerequisites, supplements, or complete replacements to traditional instructor-led learning. This can significantly impact cost, individualization, and quality of instructional design. It was with these sentiments in mind that a non-profit Manufacturing Education Program (MEP) was created to enter into the emerging domain of Web-based training. While there are many references relevant to building Web-based instruction (e.g., Khan, 1997), it was only after plunging into full-scale development that the full range of challenges and requirements became evident.

Scope of Project

MEP was charged with developing Web-based training to supplement learning in helping students prepare themselves for Machining Level One certification according to the National Institute of Machining Skills (NIMS). The timeline for project completion was six months and the total budget roughly $100,000, including labor and materials. The six training courses were to be comprehensive in content. It was specified that they include images, a glossary, search engine functionality, secure access, tests, and multiple means of "click-throughs" to improve navigation. Additionally, the courses would be hosted on a server connected to the Internet, and the system was to continuously track student interactions with course materials.

Approach

In order to create a successful team, we had three crucial aspects of the project: content development, Web development and hosting, and student interaction tracking. The team was built around our Subject Matter Experts (SMEs), who provided sufficient knowledge in-house to produce excellent content. Although SMEs may have years of experience in working with a specific area, chances are they have no formal experience in structuring content into pedagogically sound learning experiences that can be fully assessed. This is an instructional designer's task – who on this project also required an understanding of the Internet, both technically and as a content vehicle. Therefore, to address *content development*, we included both SMEs and instructional designers as part of the initial development team.

Once the content was collected and put into a curricular format exportable to the Web, it was necessary to address *Web development and hosting*. *Web development* includes everything from selecting software used for production to creating the necessary infrastructure of WWW site directories. It may incorporate coding HTML directly as well as using Web authorware, Java, JavaScript, Active Server Pages (ASP), or other languages that are the mainstay in generating well-designed, interactive, functional Web sites. *Web hosting* is the near-generic term used to describe how Web pages are made available over the Internet to the general public. Therefore, to address *Web development and hosting*, we included expertise in these areas as part of the development team as well.

In order to create the most meaningful learning experiences possible, it is necessary to seamlessly integrate *student interaction tracking* into the computer-aided learning system. This kind of tracking is useful not only to a student charting his or her own progress, but also to a company training coordinator. In order to address this third of three aspects, we included interaction tracking development as an area of focus throughout the development process.

How the Team Was Formed, and What We Learned

Because this organization did not have the in-house expertise to conduct the entirety of this project with its own resources, it was decided that an in-house project manager would lead the efforts and bring in the necessary people to see this project through to fruition. The project manager had skills in both curriculum design and Web development and management, and saw which deficiencies needed to be filled in order to successfully complete the project. In doing so, he contracted a local university's technical support for the Web development portion. The university group included graduate level students under the leadership of faculty members.

We soon learned that we had created a virtual team of two different groups – a content development group and a Web development group – in two different locations. In the literature, we have found collaborative development efforts of Web-based courses across higher education institutions, e.g., Hansen & Lombardo (1997). However, here we had a virtual team made of researchers and practitioners from a university and an industrial organization. We realized that project success was dependent, in great part, on our abilities to effectively communicate. We used two Internet technologies to achieve this goal. First was a listserv; everyone on the team was added, all email communications about the project took place via this route. The second technology was to employ our Web server as the central repository for our product during all the stages of its development cycle (not just upon completion). This maintained access for all team members to all components at every state.

Conclusion and Discussion

From this endeavor, we have ultimately learned about the vital importance of collaboration. Initially, one researcher and practitioner had an idea of the MEP and through cooperation with others, a virtual team resulted which could implement the idea and accomplish the goal. The virtual team included the roles of workforce developer, Web-based trainer, project leader, project manager, content expert, instructional designer, and technical developer. Our project is valid proof of the need for communication and the success that can result. Also through collaboration and sharing, we learned more about our various areas of expertise as well as those of others in the team. While carrying out a task, we continue life-long learning as well. This is the beauty of the Web and current Internet technology. Through realization of collaboration's importance, we can bring more people in the world together via Web-based training and other media.

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Deploying and Assessing TeamCMU – A Web Based Toolset For Student Project Teams

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Abstract: Team-based project courses offer many challenges to both faculty and students. Coordinating schedules, synchronizing work products, and communicating between faculty and students, between student team members, and between teams and clients represent a few of the special challenges project courses face. We seek to learn where electronic tools packaged together and delivered via the internet can be helpful in meeting these challenges. Although technical difficulties limited widespread adoption of the toolset during the Spring 2000 semester, preliminary findings suggest there may be benefits for teams to work with a coordinated package of team tools online.

Introduction

At Carnegie Mellon University, students majoring in Information and Decision Systems, Technical Writing, Public Administration and many other disciplines complete live-client team projects as part of their course work. Students in these project courses deal with all of the challenges common to student project teams - difficulty coordinating schedules, synchronizing and stabilizing their work products, and communicating effectively with each other. With few reasonably priced electronic commercial groupware systems available to them, however, most project teams have had to rely on email and unstructured, shared computer space for effective coordination and communication of their work activities, discussions and work products.

To address these needs, faculty at CMU developed TeamCMU – an electronic, web based, integrated software environment that developed to support team collaboration and learning in team oriented, project based university level courses (Weinberg & Bajzek 2000). It enables efficient communications within and among student project teams, course instructors and project clients and sponsors. The interface to TeamCMU requires only a web browser and a single login to provide authenticated access. For student teams TeamCMU includes personal calendars, team calendars, course calendars, secure server space for team work products, version and access control with check-out and check-in protection, meeting agendas and minutes, and discussion boards for course, team and client communications.

Student teams who use the toolset effectively benefit in several ways: reduced process time, better coordination of team resources, enhanced communication among themselves and with their clients and instructors, and reduced rework. Faculty who use TeamCMU in their courses gain experience in managing electronic communications in an orderly and organized way, hopefully reducing the need for email and other less efficient modes of communication. TeamCMU also enables effective communications between the students and their project clients by providing special client discussion boards and webspace where teams can shape and present public information to their clients on the status of their projects. This webspace might include various project documents such as the team/client contract, the initial project description document, the official design specifications, timelines, and prototypes or interface samples.

Preliminary Evaluation of TeamCMU

Research in progress attempts to demonstrate a relationship between effective usage of the toolset and overall student team satisfaction with the project, the course, and the team experience. In addition to engaging students, we hope to stimulate faculty with new ideas for course design using an effective means of implementing and managing a team learning environment. While students learn more about how teams work, faculty using TeamCMU may more easily monitor and evaluate how the teams in their courses are functioning. Creative use of the toolset may provide new insights for instructors in project based courses. For instance, instructors may require teams to provide evidence of teamwork by posting official team documents to their team space or by providing an official presentation of the current status of a project to their clients. By monitoring team calendars and discussion groups, faculty have an opportunity to identify potential problems and intervene before a team becomes dysfunctional.

During Spring Semester, 2000, TeamCMU was utilized in eight courses in Information and Decision Systems, Public Policy, Professional Writing, and Human Computer Interaction. These courses range in size from fourteen to one hundred and thirty students. Unfortunately, technical difficulties at the beginning of the semester led a sizable number of teams to adopt alternative communication/coordination methods. However, teams that used the toolset effectively felt more aware of what their teammates were doing; the faculty felt more in touch with the progress of the teams. Furthermore, teams that used most or all of the tools available on TeamCMU produced projects of higher quality than those that used only one or two tools at the site. Furthermore, one client exposed to the technology has integrated the same architecture into an intranet project developed by a student project team.

Although our limited results are only suggestive and not conclusive at this point in time, there are a number of lessons that can be learned from this experience. First, given the limited time frame of the college semester, students and faculty often seek alternatives if software is still in a pseudo-development stage. In other words, you don't get a second chance to make up for quality and performance defects in the product. Second, students and instructors need education in effective teaming before tool deployment. Furthermore, training, documentation, and a sample demonstration course are needed for acceptance of the toolset and to aid users in recognizing its full potential. Having learned these lessons and incorporated these into TeamCMU, we hope to gain further insights on how electronic toolsets can enhance team-based course work in the coming academic year.

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Enquiring Minds Want to Know: Lessons of an Online High School

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Abstract: Three years ago, The Florida High School's journey into cyberspace began as a project to better prepare students to face the realities of a connected world. The idea was to build a learning environment that parallels today's work place. Today, the school provides over fifty courses to students throughout the state of Florida. Along the way, lessons were learned about how to successfully teach high school students online, while helping them become successful life-long learners in the twenty-first century.

The Florida High School is an Internet-based high school serving the students and educators of the state of Florida. The for-credit coursework of the school is based upon Florida's Sunshine State Standards and represents a fundamental change in the educational process. In the 1999-2000 school year, FHS will offer 52 courses, free of charge to students throughout the state of Florida.

Based on the motto, "any time, any place, any path, any pace," The Florida High School delivers asynchronous learning opportunities to students who will face new demands of the 21st century workplace. The Florida High School provides dynamic, interactive, project-based, courses that produce an individualized learning environment designed to meet the diverse needs of today's students.

Courses are built around techniques that promote consistent student-teacher interaction as well as sound principles of instructional design. Florida High school courses use Gagne's nine events of instruction as building blocks of good instructional design. For example, Event 1 is based on gaining student attention. One trademark of Florida High School courses is the use of interesting, yet purposeful motifs to engage learners. For example, the chemistry course is based on an industrial theme with a nuclear power plant. Likewise, the geometry course utilizes an architecture motif, making important connections to real life situations. All courses go through an extensive peer review process to ensure that standards are met, and they lend themselves to a variety of learning styles.

Lessons Learned

Online Learning Is Not for Everyone. We have worked hard to identify the qualities needed by students to have a successful online learning experience. To help students determine if online learning is right for them, Florida High School now includes an on-line self-assessment and a teacher-generated screening phone call as part of the online registration process.

Online Learning is not for Everyone, Part II. The online educational environment is learning centered. The opportunity for the instructor to be the "sage on the stage" just doesn't exist. A great classroom teacher is not necessarily a great online teacher. At the Florida High School, we employ a team approach not only to the hiring process, but also to our staff development. All new teachers have peer mentors. Professional development and training is extensive and includes not only learning new technologies but also learning new paradigms.

The Technology Must be Adequate. Students must have access to computers that are not antiquated. Minimum requirements are listed on our website for students and parents. When students don't have computer access at home, FHS looks to the local school district to provide access equity. Sadly enough, we discovered universal access at school is a myth. The 1997 StaR Assessment (School Technology and Readiness report) found that 59% of American Schools are rated as Low Technology Schools and are not providing learning environments conducive to future workplace success. Many Florida high schools do not have enough computers, while connectivity issues remain a problem in some rural areas.

A Reasonable Pace Must be Set. "Any path, any pace" was seen by many students as an invitation to move at a snail's pace. Last year, we put measures in place to help students stay on track and thus complete the courses. Students chose an appropriate pace based on their learning styles and personal timelines. Progress reports provide the grade and the percentage of the course that is completed at each month. This information is emailed to the student, while parents and school personnel are provided on-line access to the reports so they are kept informed of their students' progress. Because of these measures, our completion rate is now up to 72%.

Strong School-to-School Partnerships are Crucial to Our Success. Florida High School recognizes the importance of strong partnerships with the public schools. To accommodate the varying needs of Florida school districts, FHS allows schools to determine which courses they will allow their students to take. The district contact for each county provides valuable feedback about the courses, and concerns the schools may be having. Guidance counselors play a key role in the day-to-day process because their signature is required on every student's AUP (Acceptable Use Policy).

Drop Policies Are Necessary. Florida High School recognizes that online learning is a new venture for most students. During our first year, we had no penalty for dropping a course but have since instituted a 28-day drop policy. As schools and students have learned to identify successful online learners, we are seeing fewer students choosing to drop.

Face-to-Face Final Exams Are Easier Said than Done. In the beginning, we used face-to-face final exams primarily for accountability purposes. However, as our numbers grew, so did the logistical problems of arranging for proctors and the mailing of exams. Next year, we will primarily use online testing, with some oral or face-to-face exams as needed.

Courses Taken in Computer Labs Are a Challenge.

- Proxy servers kept students from accessing our site.
- Servers occasionally went down, meaning students could not access their courses.
- Schools would not allow students to load necessary software onto the computers.
- Some labs were unmonitored.
- Schools did not always assist students taking our courses.

We now offer facilitator training to schools where labs are present.

High-Tech Needs High-Touch. High school students in an online learning environment need safety nets woven into the school's infrastructure to facilitate their successes. Our teachers are in contact with our students almost daily via phone, email and fax. Our guidance director maintains communication with local schools, our students and their parents. We offer students an online chat area, "Club Web", where they are able to communicate with one another in an informal basis.

In Growing Up Digital, Tapscott states, "…change a school and you change the world."[3] FHS is a learning community where the staff members view themselves as agents of change. Our school is a precursor of the changing direction of public school education.

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Using WebCT in a Communications Learning Community

Rationale for Community

During the Fall 1999 Semester, students in a Composition course and an Introduction to Human Communication course took part in a learning community. The learning community between the basic composition and speech course was developed due to several reasons. The college through the interest of the Distinguished Professor supported the project. Faculty were encouraged through on-campus workshops to implement a learning community. Participants in the project receive 1 semester hour reassigned time or a stipend equivalent to that time. Participants were expected to commit a minimum of 15 hours to the project. Of these, 8 hours were for planning, and 7 hours of direct contact with students were required. A second reason for the development of the course was the reconfiguration of the Humanities Division. Speech and Fine Arts was a stand alone department until an administrative decision was made to collapse the department into the Humanities division. One of the outcomes was a Communications component consisting of English and Speech. The last rationale for the community was the common concepts and assignments in these introductory courses.

This written and verbal communication community developed several guiding values so the students would understand the purpose behind the combined classes. The three guiding values were: (1) to have students understand the importance that verbal and written communication play in their daily lives, (2) to develop an appreciation for the spoken and written word, and (3) to have students understand that an effective communicator must develop his or her written and oral skills.

The faculty decided what common concepts would be incorporated into the combined classes. Two common assignments, an Informative paper/speech and a Persuasive paper/speech, were selected for students to collaborate on during the semester. In addition to class sessions, two library work classes were planned for the students. Students also had the WebCT page to communicate with the other class. Grading for the learning community portion of the course was based upon a percentage of the Informative and Persuasive assignments and the WebCT assignments.

Implementation of the Community

Although students knew the first day of class that they were going to be part of a learning community with another class, the first combined class didn=t take place until the third week of the semester. The first combined class was team taught and focused on Informative
communication. The class dealt with the functions of Information theory and organizing an Informative message. Students were also separated in 9 groups of 5 to 6 students making sure that each group had representation from both classes. The second class was taught by the Speech professor and focused on using visual aids and delivery in a presentation. The English class was required to do one oral presentation. The third class examined Persuasive communication and was team taught. The fourth class was taught by the English professor and dealt with appropriate language and double speak. Students were given two library work days to prepare for the Persuasive paper or speech. Both professors were available for the groups during the library time. Students were also encouraged to visit other faculty member for help on assignments.

In addition to joint class sessions, students used WebCT, a web-based, network learning environment, to communicate and share ideas with their group members. Each group had a designated Forum on the Bulletin Board in which to post responses; however, students from other groups could access any of the other forums. Having access to the other groups= postings allowed students to Avisit≅ different groups.

To facilitate communication between the two classes, WebCT assignments were designed to create and encourage a dialogue among group members. Their first assignment, for instance, was for each student to introduce himself or herself to the other group members by posting a brief biography in the appropriate Forum. Then, each student was asked to respond to one of the group members who was not in the same class. In turn, the response would generate another response, and thus a Aconversation≅ began. The other assignments followed a similar pattern. For the Informative speech/essay, students posted their topics and indicated a problem they were having researching the topic. Each group member was then asked to respond to another group member by making concrete suggestions about how he or she might approach the problem with the topic. When students were working on the Persuasive speech/essay, they posted their topic and noted several points that they planned to discuss in support of their position. The second part of the assignment was for students to respond to one of the group members with comments about his or her points and then provide several points in opposition to his or her position. This pattern of posting and responding helped sustain the group=s interaction outside the classroom.

At the end of the semester, students completed an evaluation for the course. Overall their responses were positive. The majority of students felt that the interaction with students and the instructor from the other class improved the overall quality of the course.

The majority of students also indicated that they would be willing to take another linked course. Another positive response by students was that they felt that what they learned in the course would help them in other courses. On the other hand, the majority of students felt that the learning community course required more work than a regular course. Several students commented that they would have liked more time to interact their group members, and they would have preferred to have the group work together throughout the semester rather than just on two projects.

Delivering Push Objects Using Extended Web Channels

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Abstract: Push systems focus only on the change of data, not on how it has been changed. This results in the excessively increased network traffic. And, push clients get unnecessary information in most cases. In this paper, we present a framework that exploits the existing push technology and extends it to deliver the clients what they really want to get. The framework is applied to the Product Management System whose primary goal is to deliver urgent marketing information to sales persons as soon as possible.

Introduction

Push products have suffered from the excessively increased network traffic. To reduce this push traffic, push product vendors have developed proxy servers to cache recently retrieved push objects and deliver them to push users when they are requested(BackWeb, Marimba). IP multicast is another solution to reduce such push traffic. It alleviates push traffic using multicast routing methods and network management skills(MBONE, Stark 1997).

But, these solutions only focus on decreasing the network traffic. They cannot reduce the data traffic that a user receives. In those environments, push objects are delivered to end users just because they were updated recently. That is, traditional push solutions do not deal with how information has been changed.

In this paper, we present a framework that exploits the existing push technology and extends it to deliver the clients what they really want to get. This framework is applied to the Product Management System in which urgent marketing information is delivered to sales persons as soon as possible.

Web Channel Extension

The CDF(Channel Definition Format) is an application of the XML that Microsoft is proposing as a standard way to describe a Web site channel(Microsoft Channel Definition Format). It has only the meta information of the push object such as the address where the object can be retrieved, the time when it was modified recently, and the scheduling information with which it is pushed to clients periodically. We extend the CDF to include key information of the push object. The extended CDF, CDFX, adds several attributes to the <CHANNEL> element of CDF. The newly added attributes will deliver content-related information of push objects to users. This attributes addition minimizes the modification of current push system. The following is an example of CDFX.

```
<CHANNEL SELF="http://intracast.kotel.co.kr/p1140.cdf"  SHARE="SHARPLY DOWN" REVENUE="DOWN">
<ITEM HREF="http://gray1.kotel.co.kr/revenue?empid=1140"   LASTMOD="2000-02-15T09:11">
  <TITLE> Market Share </TITLE>
</ITEM>
</CHANNEL>
```

This example represents a special case of the channel extension. We are currently generalizing the channel extension so that it can be easily adaptable to all kinds of applications.

(Fig. 1) shows the system architecture for delivering the key information of push object using CDFX file. The client program needs to be modified to process the CDFX file. And a registration process, where the Client Agent in the push client informs the CDFX Generator in the server of client preferences, is required((1)). After getting CDFX file((2), (4)), CDFX processor checks the <LASTMOD> attributes of the file. And it also examines the newly added attributes to decide whether the target object has urgent information to be delivered to the user. If the target object is up-to-date and also has urgent information, the CDFX Processor requests the target defined in the <ITEM> element of the CDFX file to the Push Server and notifies the fact to the user via the Client Agent. In the server part, CDFX generator creates(or updates) the CDFX files using client profiles .

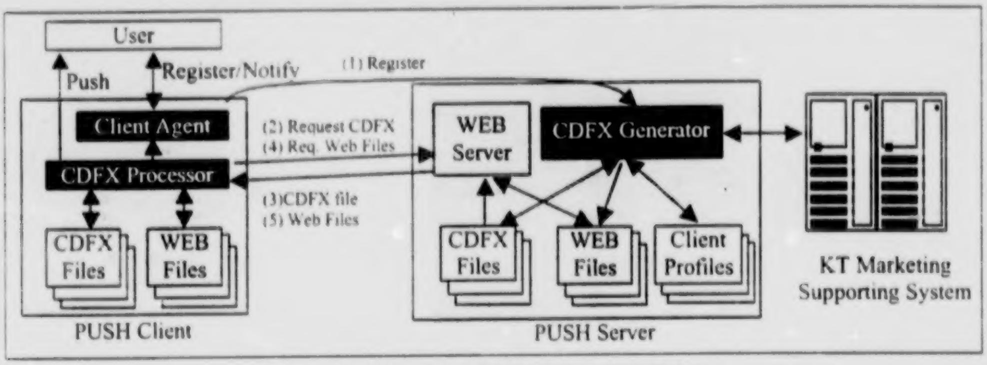

Fig. 1 : Push System Architecture using CDFX .

PMS(Product Management System)

KT(Korea Telecom) is the largest telephone company of Korea with thousands of sales persons. As new companies enter the market, market condition is getting very competitive. Therefore the KT sales persons would like to read market as soon as possible so that they can manage any changes of the market on time.

In order to help KT sales persons to manage their mission successfully, we have been developing the PMS(Product Management System) using the proposed architecture. (Fig. 1) also shows the architecture of the PMS. The marketing supporting system provides employees with marketing information in a "pull" manner. The PMS uses the data from the marketing supporting system and offers sales persons the market information about the products that they manage as soon as possible in a push manner. To do so, the PMS maintains a user profile per each sales person. The user profile contains sales goal of products managed by the sales person as well as basic user information. The goals are periodically compared to current sales revenue of each sales person that can be obtained from the marketing supporting system. If current sales revenue does not satisfy the goal, the PMS instantly reports it to the sales person by various methods such as a popup window or email.

Conclusion

In this paper, we presented a framework that uses the existing push technology and extends it to deliver push contents to clients. This framework has advantage of delivering urgent information with minimum modification of CDF. And, we exploited the architecture to develop the PMS(Product Management System) that provides sales persons with market status of the products as soon as possible.

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Web-Based Assessment

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Abstract: This paper provides the information and resources on developing Web-based tests. First it discusses potentials, the benefits, limitations, thrills and agonies on implementing Web-based assessment in education and training. Then it examines and compares various methods and Web-based testing tools for creating Web-based tests. Finally, it provides real-life examples and demonstrations on creating Web-based tests with different tools and methods.

Introduction

Testing has always been an important part of instructional process for traditional classroom courses. It is also an integral part for online learning. The purpose of testing is to determine if learning objectives have been accomplished. Formative evaluation using online testing helps students assess their level of knowledge of course material. In addition, it provides a feedback to the instructor of what students are understanding and the areas that need further explanation or clarification (Hazari, 1999).

Potentials

Though there has been a growing array of software tools developed for creating computer-based tests, many tools have been developed recently to facilitate the teachers in authoring, delivering, grading, and analyzing the tests on the Web. Web-based assessment has demonstrated its ability to deliver tests efficiently and effectively at anytime and anywhere. For these reasons, the use of Web-based assessment has experienced a significance increase recently.

The Web-Based assessment provides a way to administer, grade, and record a test via the Internet. Students can easily take the test by accessing the web site. They enter their names and other information like an ID number and password. Then they are presented with the test. When the students have completed the test, they click on a "submit" button. Immediately, the test is graded and the results are shown. Any questions that were answered incorrectly are shown along with the answer chosen by the students, the correct answer, and a brief explanation to support the correct answer.

Web-based tests have almost unlimited uses. For instance, companies can give their employees tests that insure they understand company requirements in a particular area, and colleges and universities could offer tests via the Internet to reduce paper, grading, recording, and other time consuming operations.

Benefits and Limitations

Assessment is a powerful motivator of student learning. Appropriate use of Web-based assessment can play an important role in student learning while at the same time reducing teacher workload. Unfortunately, administering, grading, and giving tests are labor intensive and time consuming tasks. Traditional tests are not flexible and student must take a test at a specific time and in a give place. The use of computers in teaching and assessment already has a considerable history within education and training. However, the rise of the Internet - especially in the form of the World Wide Web (Web), presents new opportunities for many aspects of education, particularly assessment. With the Web technology, it is possible to construct assessment which is available beyond the confines of the classroom, requires no paper or other physical resources (apart from a computer and access to the Web), can be objectively and immediately graded, and can be used for formative or summative purposes. Here are some benefits that can be obtained by conducting assessment on the Web:

- Easy access
- Flexible and can be easily customized
- Randomized questions
- Anonymous
- More cost-efficient than paper-administered tests
- Secure
- At students' own pace
- Immediate scoring and feedback
- Perfect accuracy
- Multimedia capable
- Reporting
- Statistical analysis of the results

However, there are some limitations of Web-based assessments:

- Require a large test bank
- Authentication
- Lack of standards
- Development time
- Technology dependent
- No personal feedback
- Most suitable for objective questions

Web-Based Testing Tools

Today, there are many full fledge Web course authoring tools available that integrate Web-based testing. They are capable handle variety of question types and multimedia and also provide good security, the easiness of development, maintenance and delivery of tests, item analysis, and statistical analysis of the test results. Many are proprietary in nature and not available to teachers and trainers who want to integrate testing without the use of these embedded tools. However, there are commercial testing software available as well as other methods for online testing that employ either server side or client side processing such as CGI scripts, JavaScripts, and active server pages.

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SIG PAPERS

Training Teachers in Technology – A Mountain to Climb

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Abstract: How can preservice teachers and P-12 public and private teachers be empowered to use technology as an effective teaching tool? This question becomes larger in light of numerous obstacles – lack of training time, lack of hardware and software, lack of technical support, etc. While teacher trainers cannot solve many of the school/classroom-based problems that represent obstacles, they can provide appropriate instruction to equip teachers to use technology in the teaching/learning process. Utilizing theories/models of learning that are suited to adult learners can do much to prepare teachers to be confident in their use of technology in the classroom.

Engagement Theory

Engagement theory (Kearsley & Shneiderman, 1998) contends that learners need to engage in meaningful tasks in order to learn effectively. Being actively engaged includes such activities as designing, problem solving, planning, evaluating, decision making, and discussion. The three major attributes of engagement theory are collaboration, problem-based activities, and authenticity. This instructional approach can serve both teacher education students and experienced teachers as they seek to become empowered to utilize technology as an effective tool.

Technology Training

In designing courses and in-service training the three attributes of engagement theory lend themselves to the two "layered" problem – training related to software and hardware; and training as to how to integrate technology into the teaching/learning process. Collaboration can include interaction among the students, with other teachers, with experts via e-mail and the Internet, etc. Problem-based activities can include a vast array of assignments, projects, and performance evaluations rather than traditional paper and pencil exams. Authenticity should be an overarching feature that allows students to customize their work to relate to their needs, the needs of their students, and the curriculum that they must follow. The framework of the design of the course or in-service can provide the structure in terms of the software and hardware while allowing flexibility in the application of technology skills in the teaching/learning process.

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Ethical Uses of Technology in the K-12 Environment: "It's for educational purposes so anything is fair," "I said thank you," or "It's free advertisement so they won't mind." Wrong!

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Almost every day stories appear in the news that relate to ethical issues involving technology use, many of which can have an impact on K-12 schools. Educators must deal with specific issues such as the use of email by students and staff, software piracy, network security, and student safety while at the same time keeping in mind the much broader issues of freedom of speech, the right to privacy, and intellectual property rights. The International Society for Technology Education (ISTE) standards developed in 1998 address students' understanding of ethical issues, practicing responsible use, and developing positive attitudes about the use of technology. However, educators must understand the issues themselves in order to teach and model behaviors that will stress the importance of ethical technology use by their students. This small interest group discussion will focus on what educators have done and need to do in regard to these issues. Handouts and online references will be provided.

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WORK IN PROGRESS

Template Scale for the Evaluation of Educational Web Sites

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Abstract: In this investigation we concentrated on the criteria what should be considered in developing effective educational web sites. The proposed evaluation scale of educational web sites consists of 48 different aspects divided into three units: composition of the site, general pedagogical considerations and curriculum-related aspects. Each aspect is presented as a statement and can be evaluated using the five-point Likert scale. The suitability of the scale was tested in a pilot study comparing three different types of educational resources. The presented scale serves also as a template available on Internet (*http://www.eformular.com/scale/*) and can be modified by the evaluators depending on the objectives of formative or summative evaluation.

Introduction

Evaluation of educational web resources is essential at least for two groups of persons. The first one includes the developers of web sites who are interested in improving their products in the process of formative evaluation. The second group consists of educators who must assess the applicability and effectiveness of teaching/learning materials available on Internet. We have undertaken an extensive investigation to have a survey of different considerations in evaluation of educational web sites (Adojaan & Sarapuu, 1998). Here, we mainly focused on the certain criteria what might be included in the evaluation scale applicable in the formative or summative evaluation process conducted by the developers of educational web sites.

Most of the textbooks provide the developers with the information on the composition and design of effective instructional web site (see Holzschlag, 1998; Khan, 1997). Few of the evaluation scales included some aspects of curriculum context (see Jones & Scrimshaw, 1988; Ross & Scanlon, 1995). The results of our study allowed to compose a new Evaluation Scale.

Evaluation Scale

The first unit of the Scale concentrates on the composition of the Web site. This unit consists of 27 statements divided into three subunits: general characteristics, presentation and illustration of information, and user's impression. All these aspects must be taken into account in composing any well-designed instructional web site (Reeves & Reeves, 1997).

The second unit examines general pedagogical considerations embedded in the web site (Jones, 1998). We took eight different pedagogical aspects under consideration. This part allows to get the idea either constructivist or instructivist learning approach is supported, and what kind of learning theory is considered – behavioral or cognitive. It is essential to clarify whether the goal of the site is sharply focused or it is general. In this unit the evaluators also find out what the source of learner's motivation (extrinsic or intrinsic) might be. Another aspect of evaluation estimates the necessity for teacher's presence in application of the site by students. It is presumed that excellent instructional web site provides learners with metagognitive support and meets the individual needs. One statement evaluates the applicability of collaborative learning and the last one concentrates on the possible cultural sensitivity embedded in the learning materials.

The third unit of Evaluation Scale embraces curriculum related aspects. This area is not included in most scales available in literature or on Internet. However, using educational resources teacher must clarify whether or not the presented information and educational tasks are related to the themes of curriculum. Teacher must also decide how the web site meets teaching objectives and if it is applicable without any supplementary aids (e.g. printed worksheets). In some cases the web site is applicable only for extra-curriculum activities. This unit also examines the quality of educational tasks usually provided by the site.

Evaluation Scale of Educational Web Sites

Please rank each of the following statements using the five-point scale, where the value of 1 corresponds to your complete disagreement and 5 - to the complete agreement. You can choose 0 when it is impossible to evaluate the statement or you can't find the answer.

I. Composition of the Site

A. General Characteristics

1. The objective of the site is clearly presented. (**1-2-3-4-5 0**)
2. The target audience of the presented material is clearly comprehensible. (**1-2-3-4-5 0**)
3. The navigation on the site is easy and intuitive. (**1-2-3-4-5 0**)
4. The help pages are always available when needed. (**1-2-3-4-5 0**)
5. The same design principles are used across the site. (**1-2-3-4-5 0**)
6. It is difficult to estimate the scope of the presented information. (**1-2-3-4-5 0**)
7. The navigation devices are appropriate and visually appealing. (**1-2-3-4-5 0**)
8. It is often possible to get lost on the site. (**1-2-3-4-5 0**)
9. The site is a complete unit. (**1-2-3-4-5 0**)
10. All the navigation devices are justified. (**1-2-3-4-5 0**)
11. The content of help is insufficient. (**1-2-3-4-5 0**)

B. Presentation and Illustration of Information

12. The front page is informative and reasonable. (**1-2-3-4-5 0**)
13. The overall layout is appropriate. (**1-2-3-4-5 0**)
14. The amount of information on each screen is reasonable. (**1-2-3-4-5 0**)
15. The appropriate typeface is used. (**1-2-3-4-5 0**)
16. The colors of the text are reasonable and consistent. (**1-2-3-4-5 0**)
17. The quality of illustrations is good. (**1-2-3-4-5 0**)
18. The photos enhance the presentation of information. (**1-2-3-4-5 0**)
19. The figures enhance the presentation of information. (**1-2-3-4-5 0**)
20. The audio enhances the presentation of information. (**1-2-3-4-5 0**)
21. The video clips enhance the presentation of information. (**1-2-3-4-5 0**)
22. The animations enhance the presentation of information. (**1-2-3-4-5 0**)
23. The possibilities of hypermedia are insufficiently implemented. (**1-2-3-4-5 0**)

C. User's Impression

24. The site is engaging and invites to use. (**1-2-3-4-5 0**)
25. The site is creatively designed. (**1-2-3-4-5 0**)
26. The site is technically innovative. (**1-2-3-4-5 0**)
27. The site is enjoyable to use. (**1-2-3-4-5 0**)

II. General Pedagogical Considerations

28. Constructivist learning approach is strongly supported. (**1-2-3-4-5 0**)
29. Behavioral learning theory is embedded. (**1-2-3-4-5 0**)
30. Goal orientation is sharply focused. (**1-2-3-4-5 0**)
31. The source of learner's motivation is presumably intrinsic. (**1-2-3-4-5 0**)
32. Teacher's presence in application of the site is obligatory. (**1-2-3-4-5 0**)
33. The site provides learners with metacognitive support. (**1-2-3-4-5 0**)
34. Collaborative learning strategies are supported. (**1-2-3-4-5 0**)
35. The site is respectful towards cultural sensitivity. (**1-2-3-4-5 0**)

III. Curriculum-Related Aspects

36. The information of the site is not related to the curriculum. (**1-2-3-4-5 0**)
37. The presented material is correct in its content. (**1-2-3-4-5 0**)
38. The content of the information is comprehensible for learners. (**1-2-3-4-5 0**)
39. All the terms are well explained. (**1-2-3-4-5 0**)
40. The site is applicable while teaching various themes of curriculum. (**1-2-3-4-5 0**)
41. The site is applicable for teaching without any supplementary materials. (**1-2-3-4-5 0**)

42. There are lots of incomprehensible terms in the topics. (1-2-3-4-5 0)
43. The site is applicable in extra-curriculum activities. (1-2-3-4-5 0)
44. There are enough educational tasks on the site. (1-2-3-4-5 0)
45. It is possible to modify educational tasks. (1-2-3-4-5 0)
46. The educational tasks are related with curriculum themes. (1-2-3-4-5 0)
47. The educational tasks meet teaching objectives. (1-2-3-4-5 0)
48. There is enough information on the site to solve the educational tasks. (1-2-3-4-5 0)

A Case Study

The proposed Evaluation Scale was tested in a case study. 16 science teachers who had previously passed an advanced in-service course on usage of computers in science classes participated in it. They had to evaluate 3 different types of educational Web resources. The first one – "Estonian Vertebrates" (*http://sunsite.ee/animals/*) – offered the survey of diversity of the Estonian nature and includes some electronic tests and supplementary students' worksheets. The second site – "Hiking Across Estonia" (*http://sunsite.ee/tour/*) consisted of several environmental problem-solving tasks. The third one – "Miksike" (*http://vabrik.ee/keskkond/*) – served as a learning environment for developing students' competency on environmental decision-making skills.

Teachers examined proposed web sites and filled in the Evaluation Scale available on Internet (*http://www.eformular.com/scale/scale.html*). All the teachers were interviewed to get the feedback about their opinions on the evaluation technique. The results of the case study approved the applicability of the presented Evaluation Scale.

Concluding Remarks

The described Evaluation Scale emphasizes all the main aspects to be considered in developing and evaluating effective educational web site. The proposed Scale is available on Internet. It is possible not only to examine this Evaluation Scale but everybody can use it for various formative and summative evaluations as well (*http://www.eformular.com/scale/*). The proposed example template can be modified depending on different goals and considerations of evaluators. The *5D Vision Ltd.* offers a convenient environment for creating your own form of evaluation (*http://www.eformular.com*).

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Learning State
An XML based course editor for online instruction

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Abstract: Learning State is a lesson editor that creates a control file in XML so that a designer can not only sequence lesson content but also determine how a student should engage the content. Further because of its inherent structure of XML, lesson content will be open and easily modifiable. Learning State is designed to integrate three separate parts: content, state sequence and the delivery model. We used XML to model the content by creating a DTD that orders the content to a specific type of delivery model. For example in factual information we used a linear-temporal model whereas for the concept attainment model we modeled the various examples and non-examples of specific attributes.

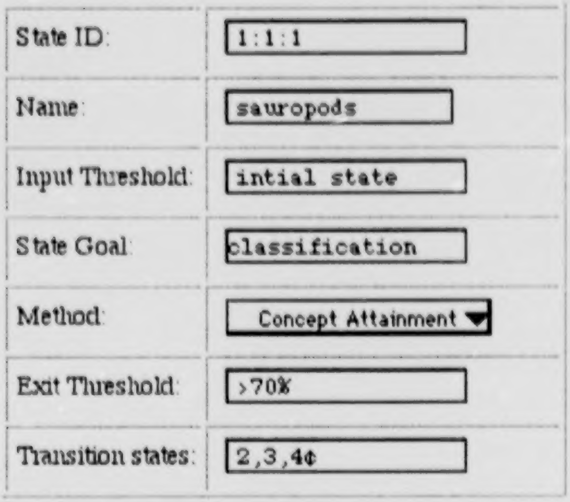
Problem

Courseware is different from other types of applications. It not only has to work flawlessly but also has to orchestrate the correct instructional delivery strategies. Originally, the delivery model was limited to direct instruction so that most courseware was nothing more than electronic workbooks or at best simple tutorials. As hardware improved, programming environments evolved so that delivery models were integrated with authoring environments. Even though these development systems revolutionized the way we create courseware there was tradeoff. The developer must Òbuy intoÓ the underlying delivery model. The developer had either tailor the intended outcome to the available technology or create proprietary solutions built from a higher level language. Either solution made the instructional content difficult to modify increasing development and delivery costs. The solution lies in creating an open development system that will be responsive but easy to use.

LearningState

LearningState is built around the Extensible Markup Language (XML) and Java 1.2 making it flexible and easy to use. We used XML to model the content by creating a DTD that orders the content to a specific type of delivery model. For example in factual information we used a linear-temporal model. Further, by using the discrete state model (Ahern 1999) we can create an appropriate sequence of sub-goals based on individual student states.

LearningState allows the designer to add, edit or delete state-nodes using a tree model. A popup window appears to create or edit a state description.(see Figure 1)



State ID:	1:1:1
Name:	sauropods
Input Threshold:	intial state
State Goal:	classification
Method:	Concept Attainment
Exit Threshold:	>70%
Transition states:	2,3,4¢

Figure 1: Example of state description window

In this example we have created an initial state node built around the dinosaurs. The goal of this state is to have the student understand the process of classification. To achieve the state, the designer selected the concept attainment model using a pull-down menu. A new window will which prompts the lesson designer to enter the appropriate content links for the concept attainment model. We can add additional delivery methods as necessary. Finally, the developer has to decide on a criteria or series of criteria that links this state to the next appropriate state as evidenced by the student performance. Once the state is defined the designer can then save the course and it is written out as an XML file.

Implications

The implications for an open protocol-based educational technology system are crucial. First it separates content from the delivery technology allowing for the rapid development of appropriate educational material regardless of the delivery technology. Developers would be free to concentrate on effective and appropriate instructional materials targeted to what teachers need for the classroom. Further, it would provide teachers with the ability to construct, modify or share computer-based materials for their classrooms thereby reducing the time needed to create course materials while substantially lowering costs.

Further development

Further development of a client as well as Java Servlet are planned to complete the development phase of the project. Further we plan more extensive development of different delivery models ranging from direct instruction to the social constructive paradigms.

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Acquiring Knowledge through the Communication in WBT Ambient

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Abstract: The importance of communication is such an aspect that should be considered when developing a WBT (Web Based Training). It's through the communication that information is exchanged and interaction between teacher and learner, and among learners as well, is established. The exchange of knowledge shall take into consideration the autonomy of the learner in the process of learning. A WBT based in the Constructivism Theory presents to the learner not an absorbable knowledge, but instead, a direction of how he must participate in the construction of his own knowledge. The orientation and the information exchange in WBT demands an environment where the communication is processed through channels always open and ready to be used. Several tools are available in the net, which can be used during all the training and in the final stage the learning evaluation as well.

Introduction

A lot have been producing for the education using the information technologies and of the communication. The multimedia resources that are offered in many of the training and teaching software are basis to attract and to stimulate the apprentices. But it demands a careful attention by not only switching the technology used, in other words, not only switching the material from printed to another source, such as in CD-ROM, video tapes, WWW pages, etc. It is necessary to get to know how to explore all the resources that a technology can offer, always concerned on creating a favorable ambient for the apprentice to build his own knowledge, starting from his needs. In the construction of a WBT, an interactive communication between the students and instructor can be richly explored. This justifies an interactive communication as a potential field where the exchanges between the students and instructor happens in deep level capable of turning simple information into knowledge. Both win in this kind of ambient. Therefore, the knowledge is acquired, through the relation subject - object - other.

WBT - Web Based Training

A WBT it is a tool used as an aid in the learning of a certain subject. The learning model in subject will be the constructivist (the knowledge is in the mental processes and in the cognitive abilities) based on valorization of the research, on discovery and on problems solutions. The WBT allows a chat's ambient between the students and educators, what turns the student into a collaborator and constructer of his knowledge when he exposes his ideas. A *web-based* course is a training tool based on the Internet's technology. The environment is created in WWW (World Wide Web) allowing the students and educators to accomplish a series of tasks related to the teaching of certain content. The great net besides being an ambient for the distribution of information, it is rich in possibilities of different communication ways between the students and educators. The administration of the course can totally be made through the Web, from the publication of the content of what will be taught to the final evaluation of the course. It finds, in this ambient, a source that enables the transmission of knowledge. The different services of the Internet, in an association of the telecommunications and computer science, turned possible: the electronic mail (*e-mail*), the files transfer protocol (*FTP*), the computers remote connection (*Telnet*) and, above all, the hypertext net (*World Wide Web*). These resources of the Internet can be explored in this course modality.

Knowledge for the communication

Taking as pedagogic basis the constructivists' theories can be affirmed that a WBT should allow to the apprentice the freedom of his learning. The asynchrous nature of a web-based course supports to the self-planned learning, making possible the instructor and the student to decide when and how to interact. The autonomous character that allows the student lead the construction of his knowledge is also a characteristic resulted of pedagogic methods proposed by Piaget, Freire and Schank. The student that seeks a WBT has the discipline, the motivation, the interest, the desire, and the need as premises for the materialization of the course that he intends to do. The learning through Internet offers available resources to learn exploratively, and self-motivated using several nature materials, prepared and available in varied moments, allowing the student to follow his own rhythm, motivated by the desire of learning and by the absorption capacity of the subjects he will find. It is important that the instructor "hears" his students in a chat ambient or through the e-mail and request them to demonstrate how they understand the meaning of what it is being approached and discussed. It should be carefully contemplated and analyzed during the whole learning process. The technologies should be seen as an ambient, a support to the presentably teaching, to the distant teaching and to the self-learning. It should not be the only ambient. Even in a WBT, it is important to consider meetings between the students and the instructor. If these meetings are impossible of happening, it should be tried to maintain an interactive communication, through chat rooms. A constant communication should be had through e-mail, so that the student doesn't feel alone during whole the learning process.

Conclusions

The communication should always be open between the students and the teacher. A participative, and interactive communication evidentially sustained by a structure non-authoritarian of teaching it is the proposal for the new teaching model. Joining this attempt of changing the concept of teaching and learning, the technologies are there to be explored along several alternatives offered. Sharing experiences, information and knowledge turns learning highly dynamic. To enroll a chat room moves the apprentice to show what he have learned and is useful as an incentive for a critical analysis of subjects provoked by the teacher during the conversation, instead of standing only as a mere information receiver and living experiences as an active agent of his learning. Behind every digital technology of information and of communication there is a man that thinks, contemplates and creates methods to try to solve or to minimize the human efforts. It is necessary to consider the man that appears due to the perception of a new contemplation of the reality. It is inside of this perspective, it is believed in the construction of the knowledge through communication in a WBT ambient.

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Project FORESEE:
*C*onnecting *C*ommunities to *C*reate *C*ompetence

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Abstract: The FORESEE Project, an online, synchronous tutoring system, connects and engages teachers, parents, students and volunteer tutors - the entire school community - in the educational process. Students are currently tutored in mathematics. The project, conducted under the auspices of the Kenan Institute for Engineering, Technology & Science at NC State University, utilizes two essential components. Electrical and Computer Engineering and Computer Science faculty and students in the College of Engineering have developed an innovative computer network. This network supports a specialized tutoring curriculum developed by faculty and students in the College of Education and Psychology. University faculty and students collaborate with faculty and administrators at a single elementary school. The pilot phase of the project has been conducted with a small sample of ten children at the elementary school. Each student was assessed with different academic measures, and each student demonstrated significant positive results.

Critical Elements of Project FORESEE

"Just-in-Time" Interactive Academic Tutoring

Educational leaders realize that even though the promise is great for computer technologies to individualize the educational process, interpersonal interaction is irreplaceable. (Coley *et al.* 1997; Yelland, 1999). In addition, tutoring is established as an effective means of individualizing instruction. Project FORESEE is designed to address the increasing need for tutors to work with students in our school system. FORESEE's system allows a volunteer to work with a student from the convenience of her/his home or office during the after-school hours. We have applied what is known about effective tutoring to our program (Lepper *et al.* 1993). The specific academic skill(s) for each lesson can be previewed and printed by the tutor prior to beginning on-line instruction. Because each student's needs are determined by the classroom teacher and the appropriate tutoring lesson plans are preselected, the tutoring session addresses the 'just-in-time' need for the reinforcement and application of skills. Because no travel is required, each session is devoted to instructing the student with pedagogically sound lesson plans so that no tutor wonders how to provide quality instruction.

A Virtual Tutoring Environment (VirTuE)

Project FORESEE's tutoring system networks an entire educational community. Each student participant is provided a computer and necessary peripheral equipment. Voice, video, and whiteboard enabled by Microsoft NetMeeting are used to provide an interactive virtual tutoring environment (VirTuE). VirTuE functions as a web server for delivery of instructions and resource materials for the tutors, students, parents and teachers, as well as a means of recording student performance data and parent, tutor, and teacher comments.

A Curriculum That Links Classroom and Tutoring Instruction

A team of curriculum specialists works with the faculty at the elementary school to develop technology-compatible lesson plans. Because the curriculum is teacher-driven, the tutoring sessions reinforce daily instruction in the home setting. The recorded and analyzed student data are used to monitor student progress, to individualize tutoring activities, and to improve the FORESEE system.

On-Line Collaboration

Project FORESEE promotes a collaborative atmosphere between and among the participants at all levels. There exists a strong collaboration between University personnel and the classroom teachers. The tutors and their students collaborate by setting goals for individual tutoring sessions and in special activities in each lesson. The parents also collaborate with their children and the tutors by providing session feedback. The tutors interact with each other by sharing the results of each session and future session recommendations.

Promising Results of Phase One

The first phase of Project FORESEE has been conducted over a ten-month period of time, from August 1999 - June 2000. At the end of June, each student demonstrated significant positive results. Each student improved in terms of both accuracy and speed, and all passed the North Carolina end-of-grade test in mathematics, with three of the students scoring above grade level.

Summary and Conclusions

We believe Project FORESEE has demonstrated significant potential for effective tutoring with school-age children. We believe we are at the forefront of demonstrating the power of an on-line, interactive tutoring program that will allow large numbers of volunteers to participate in a program that is based on the specific curriculum used in the classroom, is adaptable to the lifestyles of families and individuals, is compatible with simple, low-cost, easy-to-use computer technology, and results in significant educational gains.

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Teaching Computer Programming Online with JAVA Applets

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Abstract: The growth of Internet has made computer-mediated communication the primary mode for course delivery online. Lab interactions, which are essential to learn computer programming, are very difficult to duplicate in an online environment. Posting source codes and executables are problematic because of platform diversity. Java applets solves the cross platform issues, and allows students to experience actual debug, execute, and manipulate real programs in a real platform which are crucial for learning and motivation.

Objectives and Perspectives

The following is an exploration in the effectiveness and practicality in using Java applets to improve the quality of online computer programming courses. Programming is a complex discipline that takes time to develop. To any experienced programmer, the best way is obviously to learn by practice. Race (1993) lists four key ways in which people learn programming effectively: practice, doing it, trial and error, and getting it wrong at first and learning from mistake. An instructor should provide programming activities that will give rise to problematic situation. Substantive learning occurs in period of conflict confusion, over interactions with instructor and peers, in which students learn to analyze, apply and modify appropriate constructs in solving the problems.

Recent growth of the Internet enables and renews interest in online education (Turner, 1997). Students can access materials posted on a server, self-paced, and interact with the instructor and peers using electronic mail or computer conference as needed. Unlike face-to-face instruction, online learning does allow one to choose when and where to respond, offers the benefit of being able to participate at times and places that is personally convenient. Yet, for students studying independently at a distance, interaction is more difficult and thus less frequents (Siegel et al. 1986). For the instructor, it is also difficult and time consuming to know who is and is not participating, help and intervene those "lurk" in the background (Romiszowski & DeHass, 1989). In traditional settings, students learn by working on programs in lab sessions. Such experience is difficult to duplicate online because of the impeded interaction. Furthermore, diversity in platform restricted the use of executable files. Even when source codes are posted, they do not necessary compile error free due to configuration issues. Posted examples work more or less like pseudo code demonstrations instead of real working programs.

Java is a platform independent programming language with the ability to create applets that run inside Web pages. Schaller et al. (1997) noted applet's visual animation ability was invaluable in supporting alternative learning styles. Furthermore, its platform independence was particular useful with mixtures of equipment found among most department, personnel and students. Apart from visualizing and illustrating design concepts, would applets be useful in substituting programming labs, improve interactions, and be an effective and practical tool for teaching and learning programming online? This paper is a study in using applets for lab examples and assignments in an intermediate level programming course delivered via the Internet.

Methods and Data Sources

The course is on application and GUI programming using Java for implementation. It is designed for sophomores and beginning programming experience is expected. The online version of the course was offered as a pilot in spring 2000. It maintained a 15-week schedule, with exams on the 5th and 11th weeks and a final project. Students were assigned readings and programming exercises weekly as in the traditional class format. Lecture notes and examples that illustrate the concepts under discussions were posted on a web site. First four weeks of the course covered syntax, structure, and concepts on class and object. Since the content is non-GUI, examples and assignments are listed and due in text format source codes. Remainder of the course included GUI components, layout, events, exceptions and multimedia. Examples are given in both source codes and applets. Assignments also are submitted in source codes with the corresponding applet files.

Despite increasing popularity, it is unlikely online learning would replace traditional classroom. Growth in distance education is not expected to be from residential campuses for the 18-22 years old, but older, nonresidential students most of whom work (Appleome, 1999). In computer science, the likely audiences are engineers and technicians whose knowledge become outdated every year, and cannot take time off from job and family. For the study, students were drawn from the corporate and professional education program for a more representative sample of the online education student population. Students are working for the same employer, a fortune 500 high tech company. Most have programming as a primary duty and are quite comfortable with technology. Education levels vary widely, from AAS degree in programming, to bachelor degree in various fields. Experience levels also vary as well. However, most students are in 30s and early 40s. They should have been programming for no more than ten years. Twenty students were permitted to enroll, and all completed the course successfully. The student's employer strongly encouraged course participation. Couple with the fact that tuition would be reimbursed only for those who passed the course, ensure that students would be reasonably well motivated. Surveys were posted online. Students were surveyed on the 6th week, and both the instructor and employer surveyed also on the final week. This study is based on data from the instructor's survey as in the Appendix.

Results

All students responded to the surveys. Results showed that most were pleased overall with the course. Students in the course did very well overall. Most had very high expectations of themselves, and were unhappy with earning any grade less than an "A". Students enjoyed the convenience of doing their work whenever and wherever they please. This is an important point for the course because all students worked full time. On the negatives, students felt that they did not have the same level of interaction with the instructor as in face to face format. While they could ask questions, they did worried about missing out on questions that others asked and the instructor's responses to those questions. Students agreed that posting examples with lectures were very important. While at least five examples and one assignment were included in each lecture, students preferred even more, together with source code in text format to see how one made something work. First part of the course accepted assignments in source code only. Yet several times, students submitted binary files. The instructor had to retrieve files, unable to read them, notified students, and then reset for resubmission. The process was long and tedious, causing plenty confusion. Interestingly, couple students commented that the course started out unorganized, but improved a lot once the first exam. Coincidentally, applets were incorporated as course examples and assignments after the first exam.

Students felt that using applets in examples did demonstrate and reinforce course concepts. They enjoyed its visual and immediate effect. Quoting one response, "I was able to use the applet to see how it looks, how it's suppose to work etc. I could compile the program and immediately see the affects of program changes." Students felt applets were live demonstrations of codes that actually work while text were just pseudo code examples. Convenience from the cross platform nature of Java was also highly regarded. Anyone could run the examples on their computer and looked at the results immediately. Students enjoyed the convenient of not having to sign on to some other computers to work online. Furthermore, students did not even need the Java build time environment to be able to execute the applet examples. Students were required to submit both source codes with executable applet files in second part of the course. While one student did not think applets matter that much. Remaining responses unanimously indicated that applets were very helpful in demonstrating the detail of assignments and eliminated any guessing out on what was required. There was no negative about the use of applets. One student remarked that while downloading applet was time consuming, it was well worth the extra effort. However, Java VM version did cause some headaches. Browsers with different levels generated frustrations when applets worked on one browser and not another.

Conclusion and Significance

The unprecedented growth of the Internet has made computer-mediated communication (CMC) the primary mode for course delivery online. Florini (1990) suggested subjects such as science, mathematics and arts were not suited for CMC instruction because of its inability to convey audio, visual and kinesthetic information. Yet, Wells (1992) suggested that subject involved discussion, collaboration and reflection was best for CMC. With explosive popularity in the field of Information Technology and distance learning, 26% of higher education institutions now offer credit granting courses, and 5% offer complete degree in Computer Science by distance learning (NCES, 1999). Before online CS degrees and courses become mainstreamed, we need to know if and how computer programming can be taught effective online.

Learning theories have changed dramatically over the years. From a memorization, stimulus-response model, learning is now viewed as active construction and restructuring of knowledge. Students must carry out cognitive operations in order to acquire the content in a meaningful manner (Shuell, 1996). To any experienced programmer, it is obvious that programming can only be learned via practice: coding and debugging. Typically, it is done in labs through interactions with instructor and peers. Distance learning means instructor and students will not be in the same place at the same time. Under this constraint, instructor can best posted examples and assignments, with the hope that students will copy, modify and debug the programs. The situation worsens as platforms are typically diverse and the instructor can exercise little or no control at all. Program of the slightest complexity is likely to have compilation error due to configuration issues. As instructors pondered upon student programs not producing the supposed results, they have to wonder if it was errors in programming or configuration (Price & Petre, 1997)?

Java applet solves these problems. It can be execute as often as necessary, interactively, in reverse, repeated and error free. Students can copy source codes, and examine the affect of changing parameters or codes. By the same token, applets submitted by students should also execute error free. While one cannot ensure students actually did the work they submitted in an online environment. Assuming it does. At least the program has actually been compile and debug, and not the product of a text editor. Assignments are always a major component in any course. Applets demonstrate the details of assignments and eliminate guess works. CMC tends to reduce instructor and students interaction frequency. In such media where communication is indirect and delayed, clarity save time, avoid confusing and demoralizing students who err by misinterpreting an assignment's requirements, and who fail to ask their instructor or peers for one reason or another.

Instead of static textual material, applets empower instructors to facilitate highly visual, motivating, and interactive presentations that are accurate, repeatable, and lend well to active learning. In any programming course, the ability and experience to actually debug, execute and manipulate real programs in a real platform are crucial for both learning and motivation. Not only did students enjoy the visual and immediate effects, abilities to execute and modify sample codes greatly demonstrate and reinforces programming concepts. Though too new to evaluate completely, Java is a useful tool to be incorporate into an educational program. It has proven to be a powerful general purpose, object-oriented language that fits very well with concepts taught in many computer science courses. This study is not about if Java is better language for teaching programming. But, Java does appear to have an edge in teaching programming online because of its cross platform capability. Examples and assignments are no longer just text based pseudo code. They are real executable programs regardless of the instructor and students' environment. Now, we can have an online virtual programming lab, if only we can ensure students actually wrote the programs and ask questions when they have problem.

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The Design of a University's SACS Accreditation World Wide Web Site

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Abstract: The design of a Southern Association of Colleges and Schools (SACS) World Wide Web site to act as a living documents repository for university accreditation is an integral aspect of the accreditation process. Due to the importance of this accreditation feature, careful consideration must be placed upon the World Wide Web site design. Such issues as a simplistic and navigable flowchart, comfortable interface, and interactive elements are imperative.

Introduction

The accreditation of a university within the United States of America is of the utmost importance. With accreditation acknowledgement, the university clearly states the superior quality of the educational programs on its campus and the students who choose to attend the university are offered a semblance of assurance concerning the level of education that may be received. Without accreditation, a university does not have the implication of status that is gleaned from the stamp of successful fulfillment of accreditation status. One such accrediting organization within the southern region of the United States of America is the Southern Association of Colleges and Schools (SACS). The mission of SACS is clearly stated as imperative towards the educational system. This mission statement states, "The mission of the Southern Association of Colleges and Schools is the improvement of education in the south through accreditation" (Southern Association of Colleges and Schools, http://www.sacs.org). Through this mission statement, the clearly defined goal of SACS is demonstrated.

The focus of SACS upon universities maintains the desire to view information dispersal to all levels within the university environment. This suggests that the importance placed upon faculty, staff and student involvement within the accreditation process be of utmost importance. As a response to this aspiration, universities are utilizing the information dispersal feasibility and expedience of the World Wide Web to accomplish such goals. The development of a World Wide Web (Web) site to maintain SACS accreditation documentation, as well as expedite availability of related documents to the university community, is a useful living document repository. Due to the importance associated with a SACS Web site, universities must focus upon issues of Web site design, which include navigation, interface, interactive elements and a multitude of other factors.

Design

Instructional design has been defined numerous ways over the previous years, but perhaps the most inclusive descriptions of instructional design is offered by Winn (1990) "Instructional design is a set of decision-making procedures by means of which the most effective instructional strategies are developed or chosen, given the outcomes students are to achieve and the conditions under which they are to achieve them" (p. 53). From this description, the instructional design process is an inclusive process that maintains the integrity of the end product.

Design aspects are imperative considerations before beginning the development of any World Wide Web (Web) site. However, due to the extent of a SACS accreditation Web site, the design takes on even greater significance. After discussing the theoretical aspects of a SACS Web site with university administration, the next step was to review previously developed Web sites. Each Web site offered numerous strengths from which to draw. After carefully reviewing an ample number of SACS-related university Web sites, the development of a functional flowchart began to evolve.

Interface

The Web site interface is integral to the ease of use by the university community. Careful considerations of possible interface products were contemplated, but the simplistic aspect of Web page interface was decided upon. The interface is an important aspect to the aesthetics of the Web site. If careful consideration does not occur, the user will find the interface distasteful and will no longer desire to use this site. Therefore, the difficulty designing such a Web site will be squandered, due to the poor design implemented. The design aspects of a Web site are quite simplistic; careful consideration of navigability and information availability is paramount to the successful Web site interface.

The simplified vision of the university's SACS Web site aided the navigability and supported the desire of the university to offer informational documentation through a Web site that offered a sequential format to the user. With a graphically pleasant and textually light interface, the Web site develops an ease of structure which is pleasant to behold. Further, the use of "white space", the important aspect of allowing areas with no information to become a part of the structure, offers the desired effect of calmness and professional appeal to the Web site. Many times, the white space is forgotten in the desire to integrate as much information as possible for the Web site user. But the implementation of such tactics only aids in the user's confusion and feelings of discomfort. The final product objective must always be at the forefront of consideration when designing a Web site of such import. The focus is twofold: the university community must have access to the information contained within the Web site; and, the SACS COC representatives must have a clear understanding of the Web site's design so that the simplicity of the design will enhance the Web site's purpose and offer an aesthetic aspect of support and professionalism. The careful design of the Web site interface supports the university community and administration in efforts towards the establishment of a living documentation resource through which the informational documents are constantly available and updated.

Interactive Elements

Interactivity within a Web site is a useful format through which discussions and suggestions may occur. Two possibilities within a university's SACS Web site are bulletin boards and forms through which anonymous suggestions can be forwarded to appropriate administrative personnel, with no concern for repercussions. This interactivity allows the administration to make additions to the Web site and to reformulate areas of concern or difficulty. Therefore, the interactive nature of the World Wide Web augments the communication between the university community Web site users and the administration in a positive fashion. The interactive nature of the World Wide Web focuses upon the appropriate inclusion of interactive aspects within Web sites. This inclusion may maintain a sense of interest and consistent revision to the Web site, while further delineating the roles of the university community within the SACS accreditation process.

Conclusion

Much thoughtful reflection and effort is put forth by numerous members of the academic community towards the successful accreditation of educational institutions. Creating a supportive environment in which the available knowledge has been carefully developed into a navigable Web site for use during the university's SACS accreditation is the goal of the Web site and the university. The university community endeavors to establish a living documents repository through which the aesthetic appeal of the Web site parallels the university community and its lofty goals pertaining to academic integrity and fraternity. One way to accomplish this goal is through an interactive Web site for a university's SACS accreditation. The discussion of such a significant aspect within the educational profession must be shared and further developed so as to maintain the highest regard for academic institutions.

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Adapting Complex Courseware Systems to Support Web-Based Content Interoperability

Abstract: A report describing the adaptation of existing courseware to a web-based educational technology standards specification. Provides an introduction to the issues, definition of project scope, identification of general strategy and process, anticipated results, as well as future project direction.

Introduction

With the ongoing development of web-based educational technology industry standards such as the Shareable Courseware Object Reference Model (SCORM), it is becoming increasingly essential to enable both existing and new web-based educational courseware systems to provide support for the implementation of standards specifications. Standards such as the SCORM serve to enable the shareability of content between educational technology providers and their products, and will ultimately provide the basis for creating adaptive learning systems and the real-time generation of content. Therefore, the creation of an automated process to support the interoperability of courseware becomes necessary.

Project Scope

In the Advanced Distributed Learning Initiative SCORM version 1.0 document, three major elements are addressed. The first of these is the Course Structure Format (CSF) which deals with representing the intended behavior of the course in an .xml file. The next element is "run-time environment" which includes a definition of a standard protocol to initiate the execution of content. This also provides an interface for content-to-Learning Management System (LMS) communication, as well as a data model defining the data that is exchanged between the LMS and content at run-time. The final element is metadata which consists of course content and raw-media metadata specifications to support discoverability and facilitate reuse of the course or pieces of the course (Dodds et al. 2000). This discussion will focus mainly on the Course Structure Format specification of the SCORM, and the adaptation of courseware to fit this specification.

Strategy

After examining the SCORM and its fundamental required elements, we then identified the more significant functionality provided by our courseware system that we needed to maintain when mapping to these elements. The overall goals that were identified are as follows: 1) maintain content launchability and run-time communication, 2) preserve existing curriculum scope and sequence, as well as default learner pathing through the curriculum, 3) support assessment opportunities, and 4) enable the dynamic creation and packaging of subsets of the courseware. Once the relationship between the fundamental courseware functionality and the SCORM specifications was identified, it was then possible to define a process by which the courseware could be made compliant.

Process

While the SCORM encompasses all of the above stated goals, focus was kept on the Course Structure Format (CSF) specification and the task of adapting the curriculum to fit this specification. The work involved in the initial courseware-to-standards mapping would then be used to drive the creation of a system that would automate the adaptation process for the remaining curriculum.

The CSF contains various elements, including the "assignable unit" as the most basic curricular representation. We found this mapped directly to the "activity" level of the courseware, as each activity runs as a stand-alone, launchable and trackable unit of instruction. The information necessary to perform this launch is easily represented in a CSF. In addition, the CSF includes identification information such as an assignable unit title and description. Since all of the activities contain descriptions, this information can be incorporated here as well. Therefore, the activities can be successfully represented in the courseware without deviating from the original courseware organization.

The next structural element considered within the CSF was that of the "block." According to the SCORM, a block is a grouping of other blocks or assignable units. The CSF's provision of "nested blocks" supports the overall curriculum structure inherent within the courseware, which allows the courseware organization to be readily mapped to the CSF structure.

The sequencing of the course is specified by the "prerequisite" and "completion requirement" elements of the CSF. These concepts enable the Leaning Management System to determine and deliver the appropriate content to the learner. This is central to the courseware as it relies directly upon the function of prerequisites in order to guide the learner through the curriculum based on his or her performance on individual assignable units, as well as on blocks of curriculum. Thus, the intended default sequencing of the courses would theoretically be retained when adapting to a SCORM CSF.

Finally, the assessment functionality provided by the courseware system was considered. Because this functionality enables both the efficient and effective determination of a learner's instructional needs, it was extremely important to support this capability within the adaptation process. Although a relationship was found between parts of the legacy assessment pieces and the CSF, exploration will continue into how best to incorporate the full assessment functionality found within the courseware.

Anticipated Results

Regarding the preservation of curriculum scope and sequence, initial finds indicate that the online curriculum easily maps as content blocks and assignable units defined in the SCORM CSF. The majority of the work involved in translating the scope and sequence into an .xml file will be tagging the existing curriculum appropriately to fit the necessary file format. The development of a system to automatically provide this required functionality becomes necessary.

In addition to the curriculum scope and sequence, it was found that the assignable unit prerequisite structure of the curriculum could be supported as well. Because each of the assignable units has a defined prerequisite (or prerequisites), there is a logical instructional "flow" as learners advance through the curriculum. As a result, the intended learner "pathing" through the curriculum remains intact.

When considering the representation of assessment, a subset of the legacy assessment functionality appears to fit within the context of the SCORM CSF .xml format. This assessment enables the delivery of tests that are used to pinpoint necessary skill instruction and ensure successful skill acquisition. Assessment, then, becomes key in presenting the most relevant instruction to a learner, as well as monitoring overall learner performance in the system.

In addition, one other feature of the courseware that is intended to be maintained within a CSF, is enabling the isolation and assignment of smaller curriculum blocks found within a given course. This feature allows the system to deliver specific skill instruction to a learner without having to necessarily assign the course in its entirety. In order to communicate this functionality, different ways of accessing specific blocks of a course within the parameters of a CSF are being explored.

Perhaps the largest challenge to be expected is attempting to package the full adaptive capability of the courseware system within a SCORM CSF. Currently, this proprietary courseware system contains a fine-grained level of control over the curriculum scope and sequence, therefore providing the ability to effectively tailor instruction to a particular learner. This includes providing various levels and types of ongoing assessment, as well as continual learner performance monitoring enabling optimal instructional sequencing.

Future Plans

The representation and preservation of the system's complete adaptive capability will prove to be an ongoing focus and an important consideration in the refinement of an automated courseware adaptation process. Examination of ways to provide adaptive learning paths based on a comprehensive collection of learner profile and performance information while adhering to the CSF will continue.

Beyond the immediate task of creating an automated courseware adaptation process, the SCORM will have to continue to be monitored as it changes and evolves. The goal will be to take advantage of any new features provided by such changes that would enable a better means to address our challenges, and better support the complete intended behavior of the courseware.

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Engineering Methodology for Educational Webware Development

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Abstract: This paper proposes a methodology for the development of educational software on the World Wide Web (WWW) referred to as a "Webware". The methodology emanates from principles commonly found in software development. What can be different in the methodology is its emphasis on learning rather than commercial aspect. Analyses are conducted on learners' characteristics, the learning context and content and the technology that matches learning requirements. These factors constitute a theory of learning and instruction. Such a theory should be a baseline in the development process. The key phases in the methodology are project definition, requirements and specifications, prototype design, construction and integration, implementation and testing and finally installation and evaluation. It is assumed that by following a clear methodology, educational software developers are able to effectively use the WWW for learning.

Introduction

Quite recently, the World Wide Web (WWW) has emerged as a powerful instructional delivering tool in higher education and the corporate world respectively. The key factors that have encouraged the use of the WWW for learning relate to the fact that it has been proven as an effective platform for delivering instruction Collis (1996). But whether the Web will remain a prominent instructional tool in the future is something yet to be seen. The current success behind the educational use of the WWW can be attributed to trial and error. This is because the WWW technicalities are still unknown among educationalists. In addition, the Web technology changes much faster than its use for learning and the direction for its use can be lost. Due to lack of methodology many Web development projects are either ad hoc or poorly managed or the processes which do exist were developed for specific purposes in particular contexts (Lowe, 1999). In "Webware" development there is need to have clear goals and a plan of action to reach the goals. Goals should be able to fit into a particular learning context and a project should follow scientific methods of problem solving. In general, development methodologies for the WWW are still far from being developed. However, in order to minimise failures in learning outcomes on the WWW, this paper proposes an engineering methodology for the development of educational software on the Web. The proposed methodology is presented in the figure below.

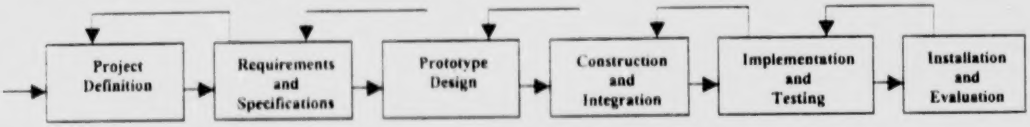
Project Definition
Requirements and Specifications
Prototype Design
Construction and Integration
Implementation and Testing
Installation and Evaluation

Figure adapted from Waterfall Software Development Model Powells et. al. (1998)

Problem Analysis and Definition

Educational software packages on the Internet are generally developed to enhance learning. They are either meant for distance education or used as learning support environments. A "Webware" can be used for delivering complete instruction to remote learners or used for posting class notes, or act as supplementary virtual resource centre for a particular subject area. Regardless of the learning goals, a clear definition of the purpose of a "Webware" can be helpful. Project definition should be derived from critical analysis of learners' characteristics, their learning styles, conditions and context of learning, the content to be learnt and the technology available to them. After the analyses are performed the goals of the project are defined (Nielsen, 2000; Daniel, 1999; Powell, Jones & Cutts, 1998; Ledgard & Tauer, 1987). Analyses results can be documented and used by a development team as a reference point in case the product has to be improved to accommodate new learning needs. Besides, a management plan is to be included in the project definition (Lowe, 2000). The result of the project definition is a written document describing all project activities whose requirements are specified in the next phase.

Requirements and Specification Phase

In this phase the exact specifications of the pedagogical and technical aspects are identified, the functionality of the "Webware" as seen by the learners is also defined. This helps to determine the technological functionality and its ability to attain learning goals. The outcome of this phase is a detailed document or plan of action describing how the project goals can be achieved. This phase is considered to be complete only if the document produced is explicit enough and easily understood by all stakeholders. Lowe (2000) argues that though definition of a clear purpose for a Web project structure, content and concepts are important, the ability to communicate the results of these definition and clarity is of great importance. "Webware" functionality only addresses what level of learning can be delivered on the WWW, how the "Webware" works in real situation is usually taken in the design phase.

The Design Phase

In the design phase the learning materials are translated into data structures and algorithms and the general structure of the "Webware" is also refined. Web design involves both visual look of the site, the structure of the information and navigation through the documents and the technology used to build interactive Web applications or perhaps more (Powel, et. al 1998). The architectural plan or design leads to the construction phase.

The Construction Phase

This stage involves the programming or coding of the "Webware". This is a stage where learning content is chunked and arranged into modules, lessons, learning activities or simulation programs depending on the complexity of the subject area and the intended learning outcomes. Most educational programs on the Web are developed for specific purposes and for specific learning contexts making standardisation of interfaces difficult. Nonetheless, it is usually helpful to test prototype on potential learners and conduct formative evaluation before implementation.

Unit Implementation and Testing

Once the prototype is developed, unit implementation and testing is performed. In testing two main aspects are considered; the learning outcomes as attained by the "Webware" and technology testing to ascertain compatibility and functionality on learners' platforms. Furthermore, it is important to ensure that the "Webware" is revised by subject matter expects, instructional designers and interface designers. Comments from different experts and learners provide important input for a formative evaluation. When all units are tested and formatively evaluated, the development proceeds to units' integration and system installation phase.

System Installation and Evaluation

In this final phase programming and coding are done and all parts are integrated, the product is finally installed on the Internet. However, before implementation on actual learners, a plan for summative evaluation is prepared. This includes how to measure the performances of the "Webware" matching it to the expected learning outcomes. It is important to conduct continuous evaluation with learners to determine to what degree the "Webware" meets the already set down learning expectations and how it can accommodate new learning needs.

Conclusion

Modern learning at universities and the corporate world usually involves heavy use of the WWW and other Internet applications. However, methods for designing the WWW for learning are far from being developed. The paper proposes a methodology that can empower educational software designers with scientific principles as opposed to artistic principles in solving real world learning problems connected to the design of educational software on the WWW. The essence of this methodology stems from learners' characteristics, content, context and expected learning outcomes. These factors also constitute a theory of learning which should be a baseline in the development process of a "Webware". The limitation of this methodology depended on how it is being used.

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Adapting the Web Development Environment for Accessible and Usable Application Construction

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Abstract: Web application accessibility requires the enforcement of a set of rules on the content written or generated with the help of Web Development Environments. W3C Consortium's *Web Accessibility Initiative* is the most significant normative effort in this direction, and provides an evolving corpus of accessibility recommendations for HTML and, in the future, for other Web languages. In this paper, we describe a practical and extensible approach to integrate those recommendations in commercial Web Development Environments by using a rule database.

Introduction

Web application accessibility can be defined as the application capability of being used by the widest range of users (disabled, elder, etc.). The World Wide Web Consortium (W3C) promotes the Web Accessibility Initiative (WAI) as a forum for discussion and normalization of Web accessibility practices. The WAI makes available a number of evolving recommendations that apply to different elements of the Web architecture. Currently, the most important ones for our purposes are the web content guidelines (W3C 1999) and the authoring tool guidelines (W3C 2000).
Most Intranet/Internet browser-based applications being developed for enterprise internal use or Web e-Commerce are constructed with the help of a *Web Development Environment* (WDE), e.g. Microsoft Visual InterDev or Macromedia Dreamweaver UltraDev. We will refer to the product of a WDE as *Web Application* (WA), different in purpose and use from a conventional web site made up exclusively of static content. We claim that the WDE is one of the most important elements to be adapted for accessibility, since its products are the applications that will be present in most of the business that require the use of computer applications. The work presented here is motivated by previous analysis of the importance of this point (García B. & Sicilia U. 2000a), (García B. et al. 2000b). In the rest of this paper, we briefly describe generic techniques for adapting a WDE to build accessible applications.

WDE Adaptation for Accessibility

By analyzing common functions in commercial WDEs, we have identified three key adaptation areas: (a) content, generated or written directly by the developer, (b) prepackaged content generated by the tool, and (c) help systems and wizards. The core component of our WDE adaptation layer (a generic name for the components added or modified) is called the *content rule-checking engine* (CRE), designed to cover the first area previously described. This module operates on WA content directly (whenever developers require it, by pressing the corresponding button) or handling some events from WDE editors. The adaptation layer can respond to those events by parsing the last line typed and taking some corrective action (showing a dialog box, for example) if some inaccessible element has been inserted. The CRE takes content fragments as input, examines them, and can return a corrected version or trigger some kind of program to correct it. The *checker* module, one of the elements inside the CRE, views

HTML/XML documents in a tree-like form, as exposed by Document Object Model (DOM)-based parsers (W3C 1998). A content rule database defines accessibility constraints on those trees. According to the rules, the *checker* modifies the HTML tree and saves it back directly or after asking for some kind of user information via dialogs (activated through some sort of *dialog executor*). Those dialogs are stored in a separate component repository in some binary or script form, e.g. ActiveX components in the Microsoft Windows platform.

The design of the rule database used by the *checker* was the result of the process of classifying WAI content checkpoints, depending on the structural part of HTML involved and the kind of corrective action needed. A rule applies on a subject, either a specific HTML item or a relationship between two of them. A detailed analysis of the Web Content Accessibility Guidelines (WCAG) checkpoints suggests the following rule subjects: single elements, attributes in the context of an element, pairs of elements and collections of attributes in the context of an element.

The kinds of corrective actions that can be applied when a rule fires are four: (a) *ensure*, to enforce the user to include an element, an attribute or some content into the element, according to rule structure; (b) *avoid*, to forbid an attribute, element or structural relationship; (c) *suggest*, to prompt the user about some recommended but no essential accessibility aspect (some WCAG priority level 2-3 checkpoints can be modeled this way) or (d) *run external algorithm*, to execute an external program to check some accessibility aspect.

In addition, some rules apply to an element only if some condition holds. This introduces the concept of *applicability conditions* (predicates that discriminate if a rule fires or not in an specific context).

Finally, when the application of a rule requires the execution of some kind of program or dialog, we must store its reference to invoke the dialog executor.

The ideas presented here have been tested in Microsoft Visual InterDev 6, as an example of adapted WDE. The adaptation layer has been modified in three ways: (a) by installing an *Add-In* developed in Visual Basic 6 in the InterDev's toolbar, (b) by adding accessible *themes* and *layouts* as prepackaged content for new WA (this adaptation is as simple as adding a new entry in some configuration files and deploying some accessible HTML templates in InterDev directories), and (c) by including a browser-based context-sensitive help for *Add-In* windows, using HTML-formatted WAI documentation.

The *Add-In* checks some rules inferred from WAI checkpoints and makes use of a set of COM components that implement user interface windows to give some advice about accessibility or gather some input from the user.

Conclusions

The quality of the adaptation layer can be measured by the increment in conformance of the WDE regarding WAI recommendations (W3C 2000) and (W3C 1999) after adaptation. In our InterDev prototype, there are three significantly enhanced areas: (a) *Add-In* dialogs incorporate context-sensitive help, and a general help section about WAI web contents guidelines is accessible from *Add-In* main window, (b) our prototype is completely integrated in the overall "look and feel" of the WDE, since the *Add-In* installs itself in InterDev's tool bar with the same appearance of any other utility, and (c), previously-checked prepackaged navigation *layouts* and *themes* allow the use of navigation mechanisms in a consistent manner. Once analyzed the underlying rules in accessibility recommendations, building adaptation layers is a relatively easy and inexpensive development. HTML parsing programs are available for free and a WA is ultimately a set of HTML pages with mixed programming code. Usability and accessibility techniques for the Web have evolved in continuous feedback and most of them are similar or complementary, and therefore the techniques presented here can also be used to enhance WA's usability.

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ON KNOWLEDGE REPRESENTATION IN INDIVIDUALIZED LEARNING

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Abstract: The proposed research focuses on knowledge representation and instructional aspects relevant to learner centric computer based learning environments. In a learner centric environment, to optimize the efficacy of the learning process the system should adapt to learner characteristics. In this paper, we propose the framework of a multidimensional learning space, with learning operators that enable adapting with respect to a category of learners. Learning varieties, learning environment and learner knowledge are the dimensions of framework. A pedagogical approach is applied to every value along the learning variety dimension. The category of a learner is not static and will change dynamically depending on the learner's measured capability and current knowledge base and also the learning goal at any instant. A system with this framework will first create an individualized micro learning space for a learner of a particular category and present to a learner a non-linear path and instruction content that is appropriate for that category.

INTRODUCTION

Our framework has as its basis Robert Gagne's (Gagne 65) fundamental assumption, which states that different kinds of learning goals require different micro strategies for learning. Considerable work has been done for individualized learning on WWW (Vessileva 97,Weber 97). A multidimensional learning space (Chan 95), for a category of learner, is envisaged which allows the learner to be placed at a suitably evaluated location in this macro space (Fig.1). An individualized micro learning space is then created for that learner depending upon a) what is being learned - learning variety, and b) how the learner wishes to learn - learning environment. The positioning of the learner depends on the learner category, say, casual or novice or expert. Further learner category is not static and will change dynamically depending on the learner's evaluated capability and current domain knowledge base. This categorization will individualize the nature/depth of learning material, complexity of examples and tests.

Given below are the values that are associated with each of the dimensions (Fig. 1).

Learning varieties: This dimension decides the granularity of the knowledge component to be used for instruction. For example, the values identified below are based on (Merrill 99 and Gagne 65) and may be extended as needed.

Part-of	The learner will be able to identify names/locations of a part with respect to a system
Kind-of	The learner will be able to identify relevant examples and non-examples of a concept
Rule-using	Learner will be able to perform series of action that will lead to some desired result
Problem Solving	Given a set of conditions the learner is able to predict the consequence of an event

Learning environment: This dimension embeds the Instruction sequencing aspect and the degree of freedom for hyperspace navigation while learning. The set of values formulated along this dimension includes *1.Dependent learning 2. Independent learning 3.Collaborative learning*. For *dependent learning* content presentation sequence is controlled by the system. It promotes reproduction of knowledge (instructor oriented) and production of new knowledge (guided discovery). *Independent learning* style uses constructivist approach that emphasizes the active role of the learner in building understanding and making sense of information. Structure of learning path is under the learner's control. System responds by providing alternative paths for content presentation. *Collaborative learning* will facilitate the grouping and pairing of learners for the purpose of achieving an academic goal .

Knowledge Level: The third dimension represents knowledge level of the learner. It is expected that the learner position will monotonically increase along this dimension. The domain knowledge itself is represented in the form of a collection of concepts. Each concept is the smallest independent blob for the purpose of instruction. Mastery of these concept blobs is used as a measure of learner's attainment of domain knowledge and thus a knowledge level.

To create an individualized learning system based on the above framework following issues has been identified 1. *Domain knowledge representation* (the topic of this paper), 2. *Teaching models*, and 3. *Learner model*.

KNOWLEDGE REPRESENTATION: This issue becomes an important design consideration for the system's ability to dynamically change the contents and learning path for an individual learner. Two main aspects need consideration *1. Knowledge structure 2. Structure of an individual concept*

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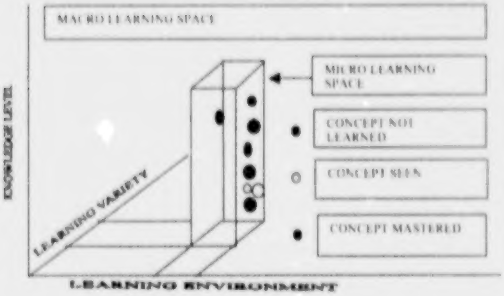

Figure 1: Individualized multidimensional learning space

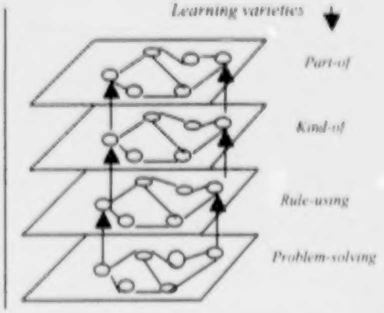

Figure 2: A four layered knowledge structure

Knowledge Structure: A Knowledge Structure is created as a multi-layered directed graph of concepts with AND-OR traversal. Each layer is representative of one variety of learning. These varieties result in different types of information/instruction content for the same concept, hence a concept can be thought of at multiple layers of knowledge structure (Fig. 2). Our framework proposes four ordered levels of knowledge structure. Every identified concept can be created as one or more types of varieties and will go as a concept node at respective layer. All the concept nodes are connected in the form of a directed graph with links. Every link is an instance of one of a number of link types (more can be identified): 1.Prerequisite-link 2.Sibling-link, 3.Child/descendant-links, 4.Analogy-links, 5.Is-a link, 6.Has-a link. The minimum connectivity that a concept node may have is with 1.Prerequisite link to a node at the same layer 2.Corresponding prerequisite link to a node at the lower layer (if the node exist), 3. Sibling links to all nodes at the same depth level on a layer and 4.All the descendant nodes at the same layer.

Concept Structure: Every concept object will be a collection of *learning operators*. Each Learning Operator will be associated with one of the dimensions of the learning space. They will have embedded in them the basic pedagogical methods and will be actually responsible for imparting the knowledge.

Presentation operators:

One learns best when information is presented in a manner most suitable for the individual. Four basic presentation modes are *TEXT, VISUAL, and AUDIO, TACTILE.*

Learning varieties operator: (Chan 95)

GOAL: The system informs the learner of the new knowledge he/she is expected to acquire in a learning episode. *INSTRUCTIONS:* System provides uninterrupted presentation of any type of knowledge. *DEMONSTRATION, EXPLAINATIONS, ILLUSTRATIONS, EXAMPLES, EXERCISES, REMINDERS, HINTS, REFERENCES WORKSPACE* are some learning variety operators.

Learning environment operators:

SEQUENCING :This operator will embed different curriculum sequencing algorithms. Choice of the algorithm *will* depend upon the position value on this dimension namely system control, Learner control

PRESENTING TASK: The system asks the learner to engage in task activities through textual/graphical Presentations. *FEEDBACK, EVALUATION, LIVE-DISCUSSION, and ADDRESS BOOK* are some of learning environment operators.

CONCLUSION

The proposed framework has the potential for application of sound pedagogical concepts to develop a tool for designing web based educational courses. The immediate work planned is related to implementing a concrete knowledge domain, based on suggested technique with embedded instructional aspect based on several teaching models (Bruce 97).

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Abstract

As *Science: Out of This World* begins its 8th year as an award-winning middle school science series, it has a new look and has embarked on a bold journey to new frontiers. This paper discusses the planning and research that went into the move from video to the web, project programming, server and development equipment, new design features, project status, and an invitation to join the experience. New initiatives include the development of modules designed to expand math content and female participation.

As satellite costs continued to climb and the number of Internet connected schools expanded, the Project Coordinator, Mike Hawkins, initiated a feasibility study to explore the potential use of the Internet as an alternative delivery vehicle. This lead to further redesign and a move away from the original linearly sequenced video-based course. The prototype for the Web-based version emerged, resulting in new non-linear, dynamically linked, theme-based enrichment modules, incorporating information from a variety of science disciplines. Active Server Pages, ASP, programming was chosen as the authoring system that best provided the data handling required for this massive effort. The basic science content is integrated by its application with one or more themes. This structure allows teachers the flexibility to teach science the way research suggests it should be taught, linked to real world applications.

The content of a single unit, Life in the Fast Lane, was selected for initial conversion. The content of this unit, which comprised 18 individual lessons, was reorganized into 5 major themes. Space topics were listed in outline form under each theme.

Simultaneously, the science content of the unit was divided into basic, stand-alone topics called instructional units. Science topics that incorporated more than one instructional unit were called synthesis or summary units. These were linked to the appropriate instructional units.

Links were then established between the space themes and topics, and the science summary, synthesis, and instructional units. The result was a collection of outlines linked by arrows that show the flow of information as one surfs the content of the site. This could be described as a top/bottom—bottom/top procedure that eventually meets in the middle, establishing links between motivational space and basic science content.

In the future, additional themes will be selected and added to the site. Each theme will link to the appropriate science content. Basic content in other subject areas will also be linked to the site themes, making this a truly multidisciplinary site, with greater subject depth and flexibility.

As the unit was converted, additional science content was inserted. Plans are to continue the process until all six units of the video course are on the web. As each unit is converted, additional science content will be incorporated. By the completion of the conversion, the site should include all the science content covered during the middle school years.

Features of the site include 16,000+ pages of content as well as:

1. E-mail updates, online and phone help
2. Separate Bulleting board and chat rooms for teachers and students
3. Streaming audio and video
4. Special NASA e-mail guest to answer student questions
5. Resources and online activities for students
6. Over 180 lab activities using common lab and household supplies
7. Quizzes and self evaluation activities
8. Posting of student work and news about how schools are using the units
9. Optional custom designed lessons and lesson plan bank
10. Home access for students and teachers

Participation in the *Science: Out of This World Wide Web* offers a variety of benefits to participating teachers, students, and schools. Students learn basic science principles and math skills supporting the national curriculum standards for middle school students. Also, the space theme of the interdisciplinary activities is motivational in many ways:

1. It helps students to think about their futures and the importance of understanding math and science.
2. It gives students the opportunity to use current technologies and develop skills that will be necessary in future job markets.
3. It enables students to interact with scientists and students from other parts of the country.
4. It builds group problem solving skills and teaches teamwork through the completion of hands-on, cooperative lab activities.

The project staff is currently working with the Educational Technology instructional design and multimedia classes to develop an on-line workshop to provide orientation and training for the classroom teacher. This in-progress addition to the program will replace the site-based training conducted for the video and early Web version of the project as well as providing an exciting opportunity for program graduate students.

Current plans for expansion of the site include development of modules designed to encourage participation by females and expansion of the math content area to support efforts to improve math scores on standardized tests by middle school students statewide.

Information is available by contacting Mike Hawkins at 1-800-259-9555 or hawkins@nsula.edu. Registration is available online at http://www.nsula.edu/departments/space-science.

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Instructional Voyeurism: A tactic to promote effective on-line learning practices.

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Abstract: This study focuses on the chronicling of four students and their instructor as they attempted to navigate the world of an on-line course. Traditional instructional principles were utilized during the development of the course and tracking features were used to gather data concerning student paths within the on-line course. Personal interviews and evaluation forms were also used to collect data to identify patterns in the use of the on-line materials and to ascertain which, if any, instructional practices appear to be most/least beneficial for the learner.

Introduction

In a digital world where degrees are being granted on-line and classrooms no longer consist of desks but of desktops there is great concern over the quality of electronic education. When discussing on-line education the issue of instructional integrity is a concern that can be seen throughout the literature. While there will always be those who challenge the possibilities of obtaining a quality education at a distance, there are others who are attempting to apply traditional instructional design practices to distance education to create effective and rigorous instruction (e.g. Dewald, Scholz-Crane, Booth, & Levine, 2000; Hirumi, & Bermúdez, 1996). The design practices being utilized involve principles that have been accepted for most instructional situations and are believed to produce quality instruction. Some of these principles include such practices as displaying instructional objectives, chunking instructional content, including instructional activities, and providing student feedback.

The aforementioned practices are activities commonly utilized in instructional practices and seen as instructionally valuable. Due to the perceived effectiveness of these practices the benefits of applying them to on-line instruction is currently being explored by several researchers (e.g. Dewald, 1999; Hirumi, & Bermúdez, 1996; Land, & Greene, 2000). However, this focus may be a bit premature. We must first discover what on-line instructional materials are actually being accessed and used before we can determine the benefits of various on-line instructional practices. Land and Greene (2000) state, "…simply providing access to information does not guarantee that students will *use* it to solve problems or deepen understanding" (p. 46). We simplify this idea further by suggesting that providing access does not guarantee use in any way. We must consider the possibility that on-line learners may not utilize or access on-line instructional options even though they are made available. In other words, while we can lead a student to "good' on-line instructional materials, we cannot make him/her view them in a constructive educational manner.

As instructors and instructional designers we carefully plan instruction for optimal learning. Despite our careful planning and best intentions students do not always follow our preset instructional paths. Historically we have been limited in our abilities to unobtrusively peek over the shoulders of students in an instructional environment to see what components of our instructional materials were being used. However, with the development of on-line course software we are able to transform ourselves into "instructional voyeurs." We have been given the ability to watch each and every on-line movement without disrupting the learning process. On-line software allows us to search for signs of instructional importance and learning preferences based on the navigational actions of the student.

This recent ability to trace students' instructional paths opens the door to the exploration of on-line instructional practices. As stated earlier, some have promoted the application of traditional instructional practices to on-line materials to promote rigorous instruction. However, it is uncertain how often students access and use these materials if they use them at all. In fact, it is feasible that some instructional materials go entirely unnoticed by students. Nevertheless, with the ability to trace students' paths, the actions of the on-line students can validate or refute historical perceptions about instructional principles and their application to an on-line instructional environment. They can also illustrate new or undiscovered patterns of learning. The electronic window through which an "instructional voyeur" peeks can provide endless instructional possibilities and information. This study explores a part of this window.

The Study

The software package TopClass was used to transfer a semester-long course for a Masters in Health Science program to an online course. Several traditional instructional principles were used during the development of the on-line version of the course including the use of objectives, chunking, graphics, activities, and feedback. The class was then "beta" tested by four students who volunteered to take the on-line course for credit. Neither the instructor nor the students had prior experience with on-line courses and none of them met face-to-face during the semester.

With the use of a tracking device in the TopClass software, data were gathered to help ascertain what components of the instructional materials were being used. In addition, personal interviews with the students were conducted at the conclusion of the course to help identify qualitative opinions of the instructional materials and the on-line instructional environment. Lastly, all four students completed an evaluation form at the end of the course containing questions related to course materials, the on-line learning environment, technical support, and the instructor.

The authors are in the process of analyzing the available data to identify patterns in the use of the on-line materials and to ascertain which, if any, instructional practices appear to be most/least beneficial for the learner. Because this study is still in progress the results are pending based on further analyses. The authors will have completed their analyses and will be able to discuss their findings at the November meeting.

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AmericasPATH

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On March 8th, 2000, Florida International University (FIU), with sponsorship from Global Crossing and support from Internet2 and STARTAP (University of Illinois, Chicago), hosted the meeting Advanced Internet Connectivity in the Americas. The purpose of this meeting was to present a proposal called AmericasPATH (AmPATH) to Latin American countries.

AmPATH is a joint project between FIU and Global Crossing, with the support of Internet2, that will create a high-speed Research and Education network connecting countries in Latin America and Mexico to the AmPATH point-of-presence (POP) in Miami. Thus, AmPath is a public/private partnership between Florida International University and Global Crossing, which will extend Internet2 to Latin America.

Global Crossing has offered to allow Florida International University and participating countries from Latin America, including Mexico, use of the available capacity of its inter-continental network to create an advanced Research and Education network for the Americas. Each participating country would receive, at no cost, the use of an ATM DS3 for three years. Access would be provided from the many POPs Global Crossing has throughout the region. Each ATM DS3 would connect to AmPATH in Miami.

AmPATH will allow the Research and Education networks from each participating country to be accessible from the United States and other international Research and Education organizations. By using Global Crossing's high-speed undersea optical-fiber network and connecting to AmPATH in Miami, participating countries in Latin America and Mexico will be able to connect their Research and Education networks to Internet2 and Next Generation Internet networks in the United States. Thus, contributing to the research and development of applications for the advancement of Internet technologies.

The benefits of this project are: 1) Research and Education networks from each participating country will be accessible from the United States and other international research and education organizations; 2) use of Global Crossing's high-speed undersea optical-fiber network; 3) use of an ATM DS3, for three years for each participating country; and 4) circuit costs shared among all participants.

Educational model for Distance Learning Program supported by Internet

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Abstract: This document describes briefly experiences and proposals of a research team that is foreseeing the possibilities of application of the new technologies in education, education seen as an instrument for social an economic development of our country. We work specifically in a Postgraduate Design program, in a public University in Mexico City: Universidad Autónoma Metropolitana.

Introduction

We think Mexico is in a transition period and we need to improve coverage and quality of our programs. The need to broaden educational coverage, the insufficient availability of educational places and the demand for flexible in regard to time and schedules, make virtual education the most viable alternative. On the other hand, the extraordinary advances in remote electronic communication media and its evident accessibility make distance education one of the best options in virtual education. Our team tries to change the traditional point of view in teaching and learning by using Internet applications, like forums, chats, mailing lists, and web pages.

Nowadays México is growing fast and technology is expanded everywhere so public universities ought to enlarge the educational offer and reach scattered population to encourage the social and economical development of the country. We need to take education whenever it is necessary so our institution is beginning to develop virtual programs to enable some part of citizens to break out the barriers of time and space.

Educational Model

Traditional and modern educational models were analyzed and then we defined a custom model (curricular design and academic-administrative structure) according to our Institution and the new media. Considering the regulations and mission of our Institution, a public higher education institution, we propose a model centered in the student, that stimulus and integrates attitudes and abilities emphasized the self-learning, promoting that students take an active roll in the construction of their own knowledge.

Nevertheless the student is the central figure of our model, the teacher is reconceived and has a great importance: he ought to encourage the students to construct their own full understandings by articulating their ideas, also is who provides activities designed to facilitate the learning process. Farther than that, he impulses in their students reflection, research and the capability of solving problems. The technology allows the possibility of creating national and even international work groups because it includes communication with other students.

According to that premises, our model identify the following instructional figures:

Design tutor: emphasizes the production of projects supported on creativity and encourage the develop abilities stimulating the thinking about concepts in graphic design criteria. Research tutor: guides the students to ask their own questions and to find the answers, explanations and constructing theories to support their projects. Counselor: Talk with the students and help them to face every day obstacles.

It means that professor's roll is to guide, help and support learning process improving organization and structuring knowledge, solving problems and social interaction by means of the media itself.

Educational Intentions of our Model

1.- Achieve high levels of excellence in the development an production of interactive products.
2.- Take advantage of the electronic communication media planning strategies that allow the optimization of the resources.
3.- Develop better educational applications in order to improve the social environment.

We tailored interactive techniques and methodologies, organized logical and psychologically for the teaching-learning process, in order to manage, encourage and promote students' develop, in the new technology scenery. We try to propose an environment based on instructional design to sort the new media, considering aspects like contents, form of presentation and instructional-approach.

Web site

The interaction man-machine must be conceived as a dialog to complete a task. The interface has to be a communication channel through which the information is transferred and the knowledge is constructed. As a medium, the interface is both, symbolic and physic, so it offers, a work environment and a control device.

Being a part of a team we took on purpose two strategies: careful planning and clear sense to success in building the site. Visual and functional continuity in our Web site organization, graphic design, and typography were essential to offer the students accurate, and useful information. We try to simplify the navigation, reduce errors and make it easy for users to take full advantage of it and features of the Web site. The first step in designing the Web site was to make sure we had defined a set of goals and objectives so that, we took on the next considerations: Identify our target audience, have a statement of purpose, specify main objectives, have a concise outline of information. The site contain and consider all graphic and editorial design parameters. According to those considerations, we established the next design strategies:

1. Define main design objectives. 2. Hierarchy information (home page, local menus pages, etc.) and structure them. 3. Entire site map. 4. Build clear navigation aids. 5. Give users direct access. 6. Try to be consistence with interface simple metaphors. 7. Create a Web site in order to keep design stability. 8. Offer a site with constant visual and functional confirmation feedback. 9. Think in screens of information, no isolate pages or presentations. 10. Provide a unique identity to the site. 11. Establish basic links using graphic buttons, navigation bars, to create visual logic, an optimal balance between visual sensation and graphic or text information. 12. Taking account on the importance of keeping links to some aids like helps, tutorials, bibliography, glossaries and cross references.

The teamwork has been concluded in a Web site dummy, which includes all pertinent considerations above. This dummy integrates a structure defined by a quite clean presentation, designed with the use of logic and clear navigation tools. It includes a constant menu bar, link buttons and graphic submenus, in order to give the user direct access, clear structure, logical references and the possibility to be glad and secure all around the site. We offer a Web site with adequate information supported by a justify design.

Conclusions

A constructivist perspective and cognitive approach has been used in designing the educational model. Visual and functional graphic design concepts and judgements has been used in the conception of the site, psychology and instructional design has been used in building the interface. Of course, quality educational programs are costly to design and implement, but they have the advantage of widespread use if they are done well.
It only lacks the experimental study. We are working in it now. We need to prove that when the students are motivated and have discipline, individual learning with virtual courses provide a more active mode of responding, detect errors in the learning process and provide high quality of learning experiences, turning them out in more comprehension and appropriation of knowledge by students.

New Approaches to Law Education: Making the Case for Web-based Learning

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Abstract: Web-based instruction and online learning are changing customary practices in education. As conventional patterns for content delivery are influenced by new and improving technologies, educators are challenged to keep up with modern innovations while maintaining pedagogically sound teaching methods. These challenges are further exacerbated by issues of time, money, quality and access. They are felt campus-wide, even among law professors, the "traditionalists of traditionalists in academia" (Frederick, 1998). This paper discusses the collaborative efforts between the Dean of the University of Tennessee's College of Law and a university instructional technologist. It examines the process used to design and develop cost-effective Web-based instructional materials, and the role of online learning in reshaping traditional law education.

Background

American law schools have experienced relatively few paradigm shifts since Christopher Langdell first introduced the "case method" of legal instruction in the late 1800s (Johnson, 1999). The last thirty-five years have brought dramatic changes in law education. This is partly due to the promotion, support and success of Web-based learning and instructional technologies. Online learning tools have been an important part of legal instruction since the development of computer-assisted legal research (CALR) in 1967. Today, large and well-organized databases such as LEXIS and Westlaw provide information to law students and professionals twenty-four hours a day. In the early 80s, the development of The Center for Computer Assisted Legal Instruction (CALI), set the precedent for the creation and use of computer-assisted legal instruction exercises and now provides access to over one hundred interactive, computer-based lessons (Johnson, 1999).

As online information networks become commonplace in higher education, instructors can begin to use the Internet and WWW to dispense information, promote out of classroom dialogue and encourage scholarly research. Nonetheless, law professors continue to rely heavily on the Socratic method or a modified version of the traditional question and answer routine. Proponents of communications and information technologies in law education suggest that traditional learning tools, including "the lecture, tutorial and printed book," cannot sustain the development of a global legal practice (Paliwala, 1999).

Participants

During the summer of 1999, the Innovative Technologies Center (ITC) at the University of Tennessee, Knoxville (UTK) initiated the Faculty First Grant Program. This program provides faculty participants with technical and pedagogical assistance in reshaping a course to include a Web-based component. One of the participants, a Tort law professor and Dean of UTK's College of Law, was paired with an instructional technology specialist from the ITC.

Procedures

The course chosen for development was Torts Two, a first-year law class in which the Dean used Blackboard's CourseInfo, a Web-based course management system. Over the course of several months, regular meetings were held to establish project goals, assess the needs of students and instructor, and plan for the online component of the course. The instructional technologist observed numerous classes in an attempt to understand something about first year law students' backgrounds, as well as their actions within the context of the course.

The decision was made to use Web-based technologies beneficial to students in the law school environment, and ones that would play to the strengths of the particular teacher. The first step was developing an online tutorial for the topic of vicarious liability, one that included a series of multiple-choice questions to which students could provide answers and receive feedback. As the semester unfolded, audiotaped weekly sessions between the professor and technologist provided the material for content outlines containing RealPlayer audio files. Students could access these "audio outlines," and other online tutorials through the class Web site. Eventually, full lectures were placed on the Web for students to download. The ability to hear the inflections in the instructor's voice, and to remain comfortable with content delivery were considered important to the successful retention of increasingly complex materials.

However, these "lectures" did not necessarily fit the traditional definition of the word, lecture. They were reproductions of the conversations taking place in the classroom. Instead, the professor took the material, condensed it, organized it, and provided it in an alternative fashion to what students received during the class meeting. Consequently, the audio lectures became a pedagogical variety for students who may not learn as effectively using the Socratic method.

Conclusions

Student feedback regarding the online materials has been positive. Students were able to download the files with relative ease and listen to them at their convenience. The instructor received numerous thanks from students for his efforts in this area. He plans to continue developing audio and video materials for use in his law classes.

Linear, text-based materials and instructor-led learning situations are being replaced by interactive content delivery systems and student-centered learning environments. In order to stay competitive, law schools must shoulder student demands for more flexible educational experiences. Web-based delivery of materials provides this flexibility while appealing to a wider variety of learning styles. The WWW can expand learning and teaching opportunities for students, while inviting law instructors to re-examine the traditional paradigms that govern their subject matter.

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An Intelligent Tutoring System On The WWW Supporting Interactive Learning.

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Abstract: Web-based education is currently a hot research an development area. Thousand's of Web based courses and other educational applications have been made available on the Web, but the problem is that most of them are nothing more than a network of static hypertext pages. This paper describes the new features of an adaptative intelligent tutoring system (ITS) on the Web.

The architecture presented in this paper provide a protected learning environment to facilate efficient learning to the students with adaptation of the learning environment to the learner's goal and capability. To produce this educational system, we distinguish three spaces :

* Adaptative navigation space to support the students orientation and help them to find an "optimal path", with use of case based reasoning technic (CBR).

* Adaptative collaboration space to use system's knowledge about different users (stored in user models) to form a matching collaborating group. The collaboration is available between the tutor system and the learner or learner/learner or group with tutor.

* Adaptative information space to adapt the content of pages to the user's goals stored in the user model.

The architecture of our system will be presented and the implementation is in high progress.

Current Issues Impacting the Inclusion of Distributed Learning Environments Within a Medical Education Curriculum

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Abstract: The introduction of educational technology within the medical school environment offers numerous challenges, especially within a distributed learning scenario. The successful integration of technology within the medical education curriculum leads towards discussion and ultimate resolution consistent with the change factors concerning faculty and administration prevalent in the medical education profession of today.

Introduction

The use of computers, the Internet and non-traditional instruction has become commonplace within institutions of higher learning. Many post-secondary colleges and universities, as well as graduate schools, have recognized that today's learners need, want and demand options for the delivery of instruction. Medical schools, like many institutions of higher learning, have also begun to recognize that they must begin to adopt a customer service mentality and provide alternative instructional delivery systems (Ayer & Smith, 1998; Christensen & Armstrong, 1998; Frisse, 1997; Salas & Anderson, 1997) if they wish to continue to attract top notch medical students and remain competitive. As medical schools begin the journey into distributed learning environments, several issues must be examined: faculty attitudes towards technology; faculty and administration attitudes towards change; faculty knowledge of and experience with educational technology; and, administrative support of educational technology initiatives.

Faculty Attitudes Toward Technology

Medical school faculty attitudes towards the integration of technology into the learning environment run the expanse of responses. Faculty members offer a varied and distinct response to the question of technology, specifically distributed learning environments, within a medical school. Positive aspects pertaining to the learner's perceived positive environmental factors and situated cognitive environments have been noted as strong factors in determining the implementation of technology within a medical school environment. Yet negative aspects revolve around the same factors. Many faculty members are not comfortable with the integration of technology into the learning environment, more specifically within the distributed learning environment where the faculty member may not have a feeling of control and expertise when dealing with a group of learners. Such factors impact the environmental elements within a medical school environment. The change factors involved in propelling faculty attitudes towards an elevated, positive attitude concerning technology must be addressed. The question raised is: what can be done to change negative attitudes to positive? Both faculty and administration must address this concern.

Faculty and Administration Attitudes Toward Change

Change is never an inviting element. The factors of insecurity, growth, mistakes and learning are all aspects of a shifting paradigm. Within a medical school environment, the change factor is much more pronounced due to the clientele who rely upon the skilled faculty who mentor the learners. The administrative support materializes in the form of technology integration plans, reward and compensation schemes, promotion opportunities, and release time for development. Through out each of these factors, the exchange of ideas and further discussion between the faculty and administration may be scarce. The difficulties that must be clearly addressed are found within such exchanges;

however, the major stumbling block is the attitudes of faculty and administration. Such faculty resistance to change can be attributed to a variety of factors, with some research theorizing that resistance to the innovation is a function of individual faculty members' personalities (Brown-Hravey, Frazer & Youmans, 1995).

Faculty Knowledge of and Experience with Educational Technology

Faculty have varied knowledge of and experience with educational technology. If dividing faculty into three major areas of experience, the following labels may apply: early adopters; late adopters; and, non-adopters. Early adopters are those faculty who have an interest in maintaining levels of theoretical understanding and desire a "bleeding edge" knowledge of the latest innovations in medical education. The early adopters have the added benefits of enthusiasm and a creative attitude towards educational tools that may further aid the learners in understanding the subject matter. Late adopters can be described as the faculty who cautiously reviews all aspects of a topic before fully implementing the educational tools. Late adopters have the added advantage of reviewing past successes and mistakes of colleagues so that they may shun the distractions of non-success. Non-adopters are traditional facilitators who refuse to meander far from the traditional path of instruction. Although the cautious aspect of the late adopters is also seen in the non-adopters attitude towards the appropriate integration of instruction, the early and late adopters maintain access to the continually shifting target of rising standards of excellence through the appropriate integration of educational technology into the medical school curriculum. But what of the non-adopters? What changes can be implemented to improve faculty knowledge of, and experience with, educational technology?

Administrative Support of Educational Technology Initiatives

The administration must lend support towards educational technology initiatives. This administrative support materializes in the form of technology integration plans, reward and compensation schemes, promotion opportunities, and release time for developmental purposes. Action-oriented support by administration offers a proactive, high profile approach towards the appropriate integration of educational technology into the medical school curriculum. This supportive environment exudes the strength and nobility traditionally emphasized in prestigious medical schools and innovation within the professional community. A more subtle support by the administration is also imperative towards the success of educational technology initiatives. Concerning need areas, a resolution to the time allocations through out the faculty professional service expectations must be elevated in importance through out the medical school. Time is precious within a professional environment such as a medical school and each innovative initiative, such as the appropriate integration of educational technology within a medical school curriculum, must be thoughtfully supported and scrupulously managed to support faculty endeavors.

Conclusion

The integration of educational technology into the medical school curriculum is a journey through several issues that must be carefully examined so that the faculty, administration and, most importantly, the learners receive an exemplary experience. Educational technology offers one avenue through which superior medical school instruction may ensue; yet, the final decision as to the appropriate integration of technology into the medical school curriculum has yet to be decided.

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Faculty Attitudes and Their Impact on the Inclusion of Distributed Learning Environments within a Medical Education Curriculum

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Abstract: Faculty attitudes and their impact on the inclusion of distributed learning environments within a medical education curriculum can play key roles in transforming today's academic medical center into the academic medical center of the new millennium. Curriculum development, instructional design, instructional delivery and administrative aspects all wield an immense influence upon the medical education curriculum. The future of distributed learning environments within a medical education curriculum rests within both the faculty attitudes and the administration's proactive reaction to such attitudes.

Introduction

In 1996, the Association of American Medical Colleges (AAMC) created the Forum on the Future of Academic Medicine (Inglehart, 1997), a venue which brings together private-sector and academic leaders to explore the future of academic medicine. For two years, beginning in December of 1996 and ending in September of 1998, members of the forum met on six separate occasions to discuss how academic medical centers will secure their futures and thrive in a market-driven environment. Over the course of these two years, a multitude of ideas aimed at transforming the medical education community were presented and debated. Faculty attitudes and their impact on the inclusion of distributed learning environments within a medical education curriculum can play key roles in transforming today's academic medical center into the academic medical center of the new millennium.

Curriculum Development

Faculty members are not comfortable with the technology that must be employed to develop the distributed learning environments (Cravener, 1999; Milstead & Nelson, 1998; Rambo, 1994). Training is rarely available to the medical school faculty to develop a sense of expertise, or at least to move beyond the novice level of experience towards a more comfortable experience with distributed learning development. Further, the time element involved in designing, developing and testing a distributed learning environment is enormous when one considers the awards system in place within institutions of higher education. Rewards and other forms of compensation must be revisited to ensure an appropriate amount of faculty time is allotted towards the development of curriculum specifically associated with distributed learning environments. Otherwise, faculty resistance towards a distributed learning curriculum will continue.

Instructional Design

Very few faculty members have developed an understanding of and expertise within the area of instructional design. Instructional design is the systematic design of instructional events, or situations, through which the learner travels towards knowledge attainment and information accessibility within a conceptual framework of understanding. The comfort level a faculty member may feel towards instructional design is understandably at a lower level than a trained instructional designer; after all, medical faculty were trained to be knowledgeable in the area of medicine.

not instructional design. The time that must be designated specifically for instructional design is also a draining factor for faculty members who must shoulder numerous other responsibilities. As previously noted, the rewards structure is not compensatory for a distributed learning environment's design, development and testing configuration. For this reason, many faculty resist the time drain associated with the design, development, testing and implementation of a distributed learning environment.

Instructional Delivery

The instructional delivery of distributed instruction can be as much of a challenge to the medical academician as design and development. The learners are not available within a face-to-face environment; the instructor can not review the learners' faces to further identify areas of confusion within the realm of understanding. The instructional style of the faculty must significantly shift to meet the needs of the new environment, and the needs of the learners within this new environment. The faculty member will find it necessary to develop a level of comfort within the distributed learning environment so that the rhythm of instruction can be systematically maintained during synchronous and asynchronous learning situations. Further, the time allocation demanded by the distributed learning environment will dramatically increase. The resistance associated with instructional delivery will mount until medical school faculty will find it difficult to maintain levels of excellence in all three of the areas of teaching, research and service.

Administrative Aspects

The administrative support for the technology initiative appears as a dominant influence on faculty attitudes towards the inclusion of distributed learning environments within a medical education curriculum (Cravener, 1999; Markham, Jones, Hughes & Sutcliffe, 1998; Milstead & Nelson, 1998). Administrative support may take shape in elements such as: allocation of funds towards the design, development, testing, and implementation associated with distributed learning environments; allocation of faculty members' time towards the successful delivery of the curriculum and ensuring a successful instructional experience for the learners; and, supporting decisions surrounding whether or not to appropriate more time towards distributed learning while lowering expectations for research or service within the higher education institution. Thoughtful consideration and careful implementation of such elements demonstrate the administrative support necessary to create superior technology initiatives.

Conclusions

Faculty attitudes and their impact on the inclusion of distributed learning environments within a medical education curriculum can play key roles in transforming today's academic medical center into the academic medical center of the new millennium. Instructional design, curriculum development, instructional delivery and administrative aspects all wield an immense influence upon the medical education curriculum. The future of distributed learning environments within a medical education curriculum rests within both the faculty attitudes and the administration's proactive reaction to such attitudes.

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The Role of Active Learning in the Comparison of Web-based and Face-to-Face Instruction

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Active vs. Passive Learning

This paper discusses the need to incorporate active learning strategies into Web-based Instruction (WBI), based on six years of experience developing online courses at the University of Alberta. For the purpose of this discussion, active learning is defined as learning in which students, "by acting on objects and interacting with other people, ideas, and events, construct new understanding" (Luckner & Nadler, 1997, p. 13). A more familiar interpretation of this definition is the saying often heard in education teaching programs across the country, which is "What I hear, I forget. What I see, I remember. What I do, I understand." Simply put, active learning strategies result in more effective learning. Its results are more long-term than, for example, rote memorization, which is often reflective of the passive learning approach. More importantly, however, active learning is an important strategy in the information age, where students need to develop a lifelong process for managing new information. According to Luckner and Nadler (1997), "the transmission model of teaching fails to prepare individuals for the future" (p.12). The question remains, however, that if passive learning strategies are less effective in a face-to-face (F2F) classroom, then why try to implement them in an online environment? The traditional lecture approach in the F2F classroom is equivalent to the text-based online lesson in terms of student involvement and learning effectiveness. Unfortunately, online courses often incorporate a passive approach to learning, and, therefore, when WBI is compared to F2F instruction, it is often criticized for its appropriateness and effectiveness.

Web-based vs. Face-to-Face Instruction: The Suspect Comparison

Some critics have claimed that "online education cannot replace the richness of face-to-face education with a professional teacher" (Alberta Teachers' Association, 1999). However, beneath this argument may be the assumption that online environments use a passive learning approach whereas F2F environments demonstrate an active learning approach. Until online instructors begin to incorporate more active learning strategies, the appropriateness of WBI in education will continue to be criticized. One approach (Johnson, 2000) for incorporating active learning in WBI is to require students to find family, friends, or co-workers to reproduce the F2F activity with them. We feel that educators who use active learning strategies in their F2F classrooms must do more than simply transfer existing activities to the Web. The transfer of these activities to the Web with the onus placed on the student to carry out the activity assumes that the student will have access to potential participants and is also the personality type to comfortably approach others and organize such an activity. Instead, it is essential that these activities be transformed. These active learning strategies must be re-invented so that they can occur completely online.

WBI has also been criticized for its reliance on text-based learning. The online instructor is blamed for not doing much more than transferring lecture notes into Web pages for the learner to read, and these resulting lessons are often described as online workbooks. There are a number of reasons why this passive learning approach is used in WBI. The primary reason is time. Instructors are often under pressure to develop a Web-based course in an unreasonably short time period, which essentially forces them to simply put their notes online. There is also a very real fear of the large amount of time required for the maintenance of online interaction, whether it be managing email or moderating a conference board, which can translate into office hours that are held 24 hours a day, 7 days a week. As a result, lessons are often designed to reduce interaction, which leaves students to only "read and regurgitate" the course material. Another reason for the passive structure of Web-based courses is the risk involved. This Web-based learning environment is new territory for most instructors, and the safest approach into this type of instruction may be seen as one with fewer interactions with students. This perceived risk might influence online instructors to choose a more didactic approach to instruction. Despite the perceived risk, the benefits of incorporating active learning strategies are great. "When students are involved in activities that lead them to discuss, question, clarify, and write about course content, we not only foster better retention of subject matter but help students' thinking abilities as well" (Meyers & Jones, 1993, p. xii).

The Solution

In order to deliver instruction that takes advantage of active learning strategies, there has to be a change in the role of the teacher. This involves less time as "*sage on the stage*" and more time as "*guide on the side*," designing, supporting, and managing the learning environment and teaching process (Luckner & Nadler, 1997). Online instructors can begin to transform their text-based lessons into more authentic activities for students by allowing students to be self-directed in their activities. Large portions of assignments can be geared toward the learner's individual interest area by taking a more project-based approach. Students can be surveyed to obtain expectations, knowledge of subject, attitude, relevant experiences, skills, etc. These needs and expectations can then influence the teacher's instructional plans. The input may be related to the method of assessment, topic of discussion, topic in a subject area, etc. In order to take student input into account, lessons should remain fluid so instructional changes can occur, therefore assignment instructions can be posted after this input has been reviewed. The structure of a topic might be prearranged, however the topic need not be solidified until a conference board discussion has taken place. Students should also be encouraged to collaborate through various activities that also emphasize critical thinking and reflection. Topics for communication via email or conferencing can be either structured or open. More informal conferences can be arranged for expressing ideas, asking questions, etc. Responding to topics can be open to all students or limited to subgroups. The instructor need not review all the posts, but assign a moderator in each group, who will then post the final group response for marking. Lastly, guest speakers may be invited into the online discussions, so that students have the rich opportunity of being able to interact with these experts in such a way that allows them "to discuss, question, clarify, and write about course content" (Meyers & Jones, 1993, p. xii).

Although some of the active learning strategies discussed require time to implement, it is important to maintain a variety of activities that involve the learner to a greater extent than is currently done with text-based lessons. The issue of time can be addressed by balancing the types of activities based on time commitment. To overcome the risk factor, instructors should be encouraged to take small steps in revising their instruction, so that any problems with implementation are not too overwhelming. This incremental approach may reduce the perceived risk and result in a more positive teaching experience. We have found that, through demonstrating and discussing with students the rationale for this change in instructional approach, the student responses are more positive. During the course development phase, the online instructor should always be aware that learning is something a learner does, not something that is done to the learner. In order for students to develop the skills and attitudes needed to become lifelong learners in the information age, educators both online and F2F need to develop activities that go beyond acquiring factual information. Before any judgment is passed on the appropriateness of WBI, though, it is important to realize that the success of any course, whether it be F2F or online, depends on the learning strategy involved more than the medium by which it is communicated.

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A Web-Based Constructivist Learning Environment for Schools - A Malaysian Model

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Abstract: This paper will discuss a model that has been developed based on the constructivist theory of learning using the web as the main interaction platform. The crux of the model is active learning and support rendered. Active learning is realized through cooperative and collaborative learning techniques. Support rendered includes the availability of rich learning resources, electronic workspaces and teacher presence. The following sections will discuss the elements of the model and how these elements have been translated into a web-based constructivist learning environment (WebClen).

Introduction

A model for a web-based constructivist learning environment (WebClen) to cater for the leaning needs of Malaysian students is forwarded based on the theoretical constructs of early constructivists (Dewey, 1910; Piaget, 1950; Bruner, 1960; and Vygotsky, 1978) contemporary constructivists (Papert, 1980; Brown et al, 1989; CTGV, 1990; and Spiro et al, 1988) and examples of constructivist learning environments (Jonassen, 1997; Duchastel and Spahn, 1996; Henze and Nejdl, 1997; and Schartz et al, 1999). Two major principles form the crux of the model, namely, active learning and support rendered (See Figure 1).

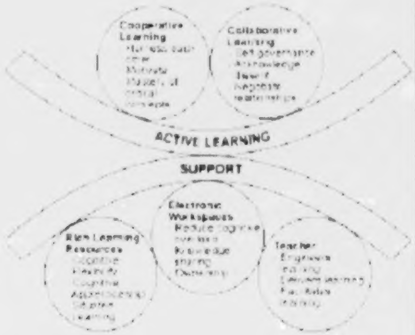
Cooperative Learning
Harness each other
Motivate
Mastery of critical concepts
Collaborative Learning
Self governance
Acknowledge
Negotiate relationships
ACTIVE LEARNING
SUPPORT
Electronic Workspaces
Reduce cognitive overload
Knowledge sharing
Ownership
Rich Learning Resources
Cognitive Flexibility
Cognitive Apprenticeship
Situated Learning
Teacher

Figure 1: A Conceptual Framework of the Web-based Constructivist Learning Environment (WebClen)

Active Learning

Active learning refers to the following: all students are actively involved in knowledge construction; students decide on some of the learning activities; students discuss their ideas with their group members; students seek for help when they face a problem; and students self-check on their progress. This is realized through cooperative and collaborative learning.

The WebClen supports cooperative learning which enable students in a group to harness each others ability, skill and knowledge, to motivate each other, and increase their mastery of critical concepts. The elaboration of materials

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by students will also enhance retention and retrieval of information (Wittrock, 1978). It is hoped that the cooperative learning methodologies employed in the WebClen will aid learners to reach their Zone of Proximal Development (Vygotsky, 1978). The WebClen also supports collaborative learning principles such as enabling students 'to govern themselves' (Bruffee, 1998) acknowledge dissent and disagreement and cope with the differences.

Support Rendered

Students need to be supported in their learning processes. In a web-based learning environment, support is given in various ways, which includes the availability of rich learning resources, electronic workspaces and the teacher.

Rich learning resources are important for the development of cognitive flexibility and advanced knowledge acquisition (Spiro et al, 1989). Rich learning resources also support authentic or situated learning experiences based on cognitive apprenticeship principles. As an information apprentice, the learner is expected to access a wide range of resources.

To support student construction of knowledge, the right "cognitive or mind tools" (Jonassen, 1997) need to be made available. In the WebClen, these are referred to as workspaces. The principles underlying workspaces are that they should allow: any one student in the group to key in the group answer; the information to be easily viewed by the learner, teacher, expert, parents and any other interested party; for easy input of information in the form of text and multimedia images and the learner to make changes easily.

In the WebClen, the teacher is seen as playing three roles, that is the teacher engineers the learning, delivers the learning and facilitates the learning. In engineering the learning, the teacher structures the learning environment. One important aspect of delivering is to ensure that students see the whole picture and are able to connect previously acquired concepts to present and future learning concepts or topics. The teacher facilitates by assisting the students with technology, bilingual and content issues as well as provides motivation and monitors students' progress.

Implementation

The model was implemented with the creation of a web-template. The web-template has six major components to it, namely the Links, Create, Media, Expert, Quiz and Center. The template provides the environment for active learning and support rendered. Apart from that, support is provided in terms of printed notes, books, encyclopedias and electronic databases. Simple experiments are also conducted to allow students to have a more realistic learning experience.

Conclusion

The two major issues considered in formulating the WebClen were active learning and support. To support active learning, the web-template was considered an important element. The web template not only allows learners to have a more fulfilling learning experience, it also allows teachers to easily create their learning activities. Support from co-learners, the teacher and other experts was also an important factor. In short, the WebClen motto is that the student thinks, the teacher guides and the computer facilitates.

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Ambient, Balanced, and Continuous Development of e-Services

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Abstract. Specialized independent e-services will extend today's web-based e-business systems used by large and small companies to communicate with partners, to connect with their back-end systems, and to perform electronic commerce transactions. The transition to widely used e-services will not happen immediately. We need methods, tools and development processes. This paper reports on results regarding e-service evolution based on ambient development. Ambient development is an approach to service generation using spontaneous service networking and user feedback. An environment is presented in which virtual modelling methods are applied to ambient development of e-services.

Introduction

Specialized independent e-services will extend today's web-based e-business systems used by large and small companies to communicate with partners, to connect with their back-end systems, and to perform electronic commerce transactions. E-services can support order procurement, on-line trading, customer relationship management, product promotion, or real-time car navigation. The transition to widely used e-services will not happen immediately. We need methods, tools and development processes. This paper reports on results regarding e-service evolution based on ambient development. Evolution of e-services is of fundamental importance as a method to reach high quality services, and to successfully respond to new user requirements and changing operation conditions and technology.

Ambient development projects

We report on the results of several projects contributing to the common theme of ambient development of e-services (Krzanik et al., 2000). Both production and training projects were involved. The use of virtual visual modelling was of primary interest. Recently virtual modelling has been extensively used in both e-business and e-commerce. A number of studies indicated their role in service development and operation. There has been relatively little experience regarding application of virtual models to e-service evolution. We were interested in environments, which handled mixed, virtual and real models, reuse, component orientation, product lines, and represented user-participative development. An ultimate goal was to support e-service specification, selection, composition, delivery, monitoring and analysis, and quality evaluation.

The work reported here was motivated by increased demand for mobile added-value services, and by such trends as computing mobility, virtual companies, etc. Applications may run on different information appliances, smart phones, wearables, wireless toys, contact less chip cards, data shadow (tag) processors for smart objects, etc. The facilitating factors include progress in communication technologies, ubiquitous connectivity, and new approaches such as spontaneous connectivity.

Ambient, balanced and continuous development

Ambient e-service development is an approach based on spontaneous service networking, configuration and rebuilding, with special emphasis on early and frequent user feedback. Feedback helps getting better control of the project by providing facts about how things are working in practice. Only early and frequent feedback matches the dynamics of spontaneous service networking and rebuilding. Services in an open, distributed, dynamic world find each other and form a transitory community. Problems of spontaneous networking include the assumption of no a priori knowledge about existence, interface, functionality, or trustworthiness of other services (as opposed, for example, to conventional client-server model). Ambient development makes assumptions similar to those of ambient computing (ubiquitous computing, pervasive computing), except that the focus is on the development stage and evolution rather than operation. The development processes are predefined (may be specialized for individual types of services), and the degree of task automation is high. Ambient development moves to the background. Service development becomes "calm", to reach "development without development tasks". Ultimately, invisible development processes become an integral part of the natural human environment, and the ubiquitous background assistance supports invisible development. Developers concentrate on the goals not the tasks. Service development is enriched with the real world user information and is becoming "smart" (in a similar way as, in pervasive computing, smart services are spontaneously configured while sensors capture the environment). In our projects ambient development was supported by the application of virtual models for both operation and development. The models were designed to represent critical aspects of the e-service so that early and frequent feedback was possible. A tracking function allowed user feedback with the optimum user overhead effort involved.

Continuous development is an approach to e-service development that merges development and operation of e-services by introducing evolutionary practices to service development. An evolutionary project is consciously divided up into small, early and frequently delivered, stakeholder result-focussed steps. Each step delivers benefit and builds towards satisfaction of final requirements. Step size is typically a small fraction of total time or budget. This results in realistic feedback about the ability to deliver meaningful results (Gilb, 2000). In our projects the virtual models representing critical aspects of e-services were generic. That in most cases allowed online simulation, implementation and deployment of small incremental deliveries.

Balanced development stresses the ability to deliver meaningful measurable balanced results to the stakeholders. The method is based on the ability to control multiple objectives. It attempts to simultaneously track and manage all the critical factors. The associated feedback includes information on design suitability, stakeholders' reaction, requirements' tradeoffs, cost estimation, time estimation, people resource estimation, and development process aspects. In our projects, balanced development is possible through the support of multiple stakeholders' feedback and coordination. For example, as in our projects, the support can be provided to coordinate, with the Inspection method, the measurement of stakeholders' service standards violations. This can be done in sample areas of any software or marketing specifications.

Implementation

The environment in which virtual modelling methods were applied to ambient development of e-services included the following basic parts: Users, Virtual Model with User Coordination and Internal Services, Configuration and Communication, External Services. An iterative process was applied, with iterated one-step development process including the following stages: Goal Setting, Initial Design, Advanced Design, Early Transition, Transition, Deployment, Specific Variants (the last one resulting from application of specific technologies such as Jini or Bluetooth). Perhaps most interesting were the Coordination and Configuration functions. The Coordination function monitored and synchronized multi-user (end-user, developer) access to the virtual model to support two general activity types that supported ambient development: "track" and "share". An interesting solution was the application of the Inspection workflow. The Configuration function selected and configured individual services to assure their consistent behaviour during both development and operation. Of particular interest was the application of a pattern-driven approach to service configuration.

Conclusion

We developed and outlined in this paper an approach to ambient development of e-services. The obtained early results confirm the applicability of the method for both production and training purposes.

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Neural Networks as an Enabler of Distance Education

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Abstract: In this paper the author addresses the use of neural network technology in the creation of on-line learning environments. These environments are an option for helping instructors deal with high student to instructor ratios and maintaining quality education while controlling costs and resources. Neural network technology is flexible enough to enable the creation of authentic simulations, personalized tutoring, and multimodal interaction, as well as individually monitoring the progress of each student. The use of hybrid technologies, such as those which combine neural networks and software agent components are capable of facilitating not only distance learning environments, but the performance of the institutional networks which support them.

Introduction

The high student to instructor ratios currently encountered in many instructional institutions are frequently the result of those institutions attempting to accommodate the needs of a growing student body that is becoming increasingly diverse in terms of background, age, and qualifications (Ma, Lee, Du, & McCahill, 1998). Because these students are frequently constrained from access to traditional educational situations due to factors including time, distance, and non-school commitments, institutions have responded by increasing the number and type of course offerings. However, many institutions also find a parallel trend of increasing cost restraints on the already limited resources of funds and staff, which are required in order to teach those classes (Newton, 1998).

These strains are forcing institutions to use using non-traditional approaches, such as distance education, in order to meet their requirements. Institutions usually choose one of three major distance education formats, which include the traditional printed correspondence course, the industrialized multimedia course, and computer mediated multimedia courses (Jones, 1996). The first two options leave the student isolated, while the incredible potential of the third has been limited through a combination of diverse factors. Chief among these is the inadequacy of the fundamental technology to support the level of interactivity needed to achieve either the overarching general goals of educational effectiveness or the more specific goal of accommodating the prime learning style of each student (Luketina, 1994).

However, there is a fourth option, which is the creation of distance learning environments enabled by artificial neural network (ANN) technology. These environments are designed to provide authentic simulations, tutoring, multimodal interaction and monitor individual student progress as well. The capability to individualize instruction in accordance with the needs of the student has been proven to provide results superior to traditional methods, regardless of the subject being taught (Johnston, 1975).

Applications within the Learning Environment

Using the results of personalized instruction as the goal for creating effective learning environments, a major component of the environment must be dedicated to tutoring. This component must be capable of providing all the elements that characterize individual instruction. These include: providing immediate feedback, constantly evaluating student performance, allowing students to master basic material before introducing advanced concepts, and identifying and reinforcing areas where the student is having difficulty.

An excellent example of the use of ANN technology that provides all of the elements of personal tutoring, is the Adaptive Network Solutions Research (ANSR) project that was sponsored by the US Department of Education in

1996. The purpose of this project was to use neural network technology to tutor math students with learning disabilities. In this instance a self-adapting ANN was designed to track the current factual knowledge of the student and introduce new knowledge with near-optimum sequence and rate. This was done using visual animations that illustrated concepts, and providing immediate positive feedback to the student (Mead, 1996).

Lively (1992) also used the pattern matching and predictive capabilities of ANNs to predict student responses and then provide feedback until the student response would become similar to the answers contained in the knowledge base of the system. The variation between the student responses and the correct answers served to show a pattern of error that was analyzed by the ANN, and used to provide individualized tutoring. This approach can be used in any area where knowledge is highly structured and can be represented in patterns. This would include language, mathematics, science, physics, music, etc.

A truly interactive environment might integrate speech, gestures, text, voice, images, real-time video, and may also include traditional pointing and selection tools. This allows the student many choices for communicating with the system. This multimodal approach is ideal because it accommodates every learning style, and allows participation by students who previously could not use distance learning environments due to a disability.

One example is the integration of ANNs designed for gesture recognition. Murakami and Taguchi were able to successfully train a recurrent neural network to reach a 96% recognition rate using sign language and a data glove (1991). Pavlovic, Rajeev, & Huang, (1997) took this concept to its logical conclusion, and used a camera to enable the system to monitor and respond to human movements. One of the impediments to this type of interaction has been the inability of traditional technologies to differentiate between valid signals and extraneous noise. Fortunately, this inability has been overcome by the fault-tolerance capabilities inherent in ANN technology.

ANNs are also combined with software agents to form intelligent agents. This hybrid technology is frequently used to create training simulations. For example, in chemistry, they are already used to identify chemical components in mixtures, and to optimize formulations. In training meteorologists, simulations are used to track and predict the outcome of atmospheric events.

They are especially useful in areas where skills must be perfected before they are actually used in a real-life situation. The areas of medicine and pharmacology provide several excellent training examples. In pharmacology, neural networks create simulations that can accurately predict the medicinal properties and effects of drugs (Widrow, Rumelhart, & Lehr, 1994). In the medical field, they are used for everything from artery tracking to help diagnose coronary artery disease (Hanna & Campbell, 1995) to simulated neurosurgery. For example, Billinghurst and Savage (1996) developed a three dimensional nasal cavity that provided medical students with assistance in surgical procedures. In this instance, the environment monitored the actions of the student, and was programmed to intervene and provide direction when necessary. Since it was also capable of understanding and processing natural language, it had the ability to understand and respond to student questions.

The application of ANN technology, especially in the form of intelligent agents, goes beyond the leaning environment to the actual network where the environment resides. Intelligent agents designed for efficient information retrieval use less bandwidth than traditional databases that have vector space model information retrieval mechanisms. This technology can eliminate bottlenecks and information latency that frequently accompany the use of current search tools. This cuts communications costs to the institution and provides quality results to the user in less time.

Conclusion

In order for educational institutions to cope with the burgeoning population of non-traditional and geographically dispersed students, it is vital that they take advantage of technological solutions. However, the technology chosen must be as effective as personalized instruction.

An excellent solution is to use neural network technology as a basis for creation of simulation-based learning environments. The examples already cited show that the approach is both workable and effective. The flexibility of the technology allows it to be implemented in various ways so that it is applicable across a wide variety of course offerings and departmental budgets.

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Internet-Based Distance Education: Barriers, Models, and New Research

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Abstract: The rate of success of a student in Internet-based distance education courses is usually attributed to several factors. One must examine all of these elements in order to assess how each facilitates or impedes the knowledge to be gained. In the new millennium, adult learners will become the fastest growing segment of higher education (Ben-Jacob, Levin, & Ben-Jacob, 2000; Galusha, 1997); this will call for a greater need to offer quality off-campus, Internet-based courses. With the rise of technological advances in delivery systems (Bonk & Dennen, 1999), we will see a unique meshing between student and telecommunications. The following observations involve adult distance learners.

Barriers

Contrary to the potential 'facelessness' of Internet-based distance education, there is no other teaching method that requires more collaboration between the student and the instructor (Galusha, 1997) than distance education. While traditional roles of student and teacher are ever changing, in distance education, instructor feedback is still extremely vital to the student for self-evaluation, task orientation, instructor support, and flexibility (Jegede, Fraser & Fisher, 1995). In place of the face-to-face meeting, students in a distance course can utilize 'low-end' videoconferencing to maintain a synchronous connection and still receive immediate feedback from an instructor (Kueker, Jackson & Walker, 2000). Text-based synchronous media also allow interaction from members of a class discussion in real time with any number of students. Telecommunications and Internet resources allow participants to share ideas and exchange scholarly work (McIssac, 1992). Individual e-mail and class e-mail discussion groups can also help to bridge the isolation gap by allowing the exchange of textual thought and documentation.

Distance learning also encounters the problem of supporting study skills. Two key factors play an important role. First, for success, the learner must feel the need to learn and accept a share of the responsibility for planning time wisely, searching out needed information or skills, and participating actively (Rezabek & Weibel, 1995). Secondly, instructors must embolden their students to manipulate the environments to be conducive to learning and establish an atmosphere where students feel secure (Rezabek & Weibel, 1995). Study skills are relevant to the individual, yet the tools for acquiring them are not as important as the person's inward drive to be proactive and assume responsibility for learning (Rezabek & Weibel, 1995).

The student's level of experience with technology correlates directly to whether or not it is a barrier in distance education. For success in distance learning, technical concerns must be made a non-issue (Galusha, 1995). The instructor must ascertain the level of technological expertise of each learner and then select tools or programs, which fit the users' abilities. Synchronicity is not a critical matter; the familiarity or ease of use becomes much more important. Tools such as message boards, class e-mail discussion groups, or newsgroups allow ease of use for students. Internet-based teaching tools which need special protocols such as Internet relay chat (IRC) or C-U-SeeMe, hinder a student's ability to become successful. Moreover, research suggests that diminishing the requirement to rapidly respond by using more asynchronous tools and class interaction techniques "increases the quality of the learning environment and enhances learning" (Goh & Tobin, 1999, p. 170).

Models

The *distributed classroom* model may have small satellite groups of students at locations outside of the 'home' classroom. The instructor and school control these, with little control exercised by the student. This traditional system requires synchronous communications. However, visual contact greatly enhances learning and may be crucial to the success of the learning activity (Rezabek & Weibel, 1995). Direct e-mail, computer moderated classrooms (CMC), or message boards may aid in student learning through additional instructor feedback. The *independent learning* model relies on numerous telecommunication tools and Internet resources. A student may utilize e-mail, e-mail discussion groups, CMC, or a message board. Asynchronous tools allow for the learner to set their own pace, "although the learning goals should drive the selection and use of the technology" (Rezabek & Weibel, 1995). The *open learning plus class* model involves traditional printed text and computer disks or videotape. The class meets at appointed times for the instructor led portion, using online tools to enhance the model rather than act as the main tools for delivery. The use of both asynchronous and synchronous systems provide for a wide variety of applications by the student and instructor in this model (McIsaac, 1995). Distance learning provides for equity in educational opportunities. Most adult distance learners are more dedicated and tenacious; they are willing to learn new technologies or use different distance learning models because experience has taught them that education is the key to success (Ben-Jacob, Levin & Ben-Jacob, 2000).

Research

Research and evaluation in distance learning relies heavily on the assessment of a student's academic achievement and other outcomes that are valued in learning. However, traditional assessment does not give a complete picture of the process of distance education (Fraser, 1998). Walberg and Moos (in Maor, 2000) pioneered learning environment research (LER) independently in the late 1960s/early 1970s. LER utilizes the *beta press*, whereby the shared perceptions of the students and teachers are analyzed to extrapolate qualities of classroom learning. Often this is done using pre/post survey instruments. While these LER instruments have been validated, they have not been widely used in a distance education environment to measure the value of distance education models or realize the barriers outlined above. The psychological aspects of LER, combined with a consideration for Internet-based distance education barriers and models, should be the next step, reaching beyond traditional assessment of students' academic achievements, in evaluating distance education programs to increase achievement in adult learning in web-based distance education.

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A method for studying the variability of users' thematic profile

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Introduction

This document aims at introducing a method for studying thematic profile variations of Internet surfer. These profiles are characterised by the extraction from a proxy cache of web pages consulted by each user. A semantic analysis of the content of these pages allows us to generate a vector that represents users' mains interests. This way of processing is close to the Salton representation method [SAL74]. One vector is a sequence of words whose weight reflects the co-occurrence of word sets in pages. These weights are computed and updated as the learning stage analysis of pages progress. Vector is a multidimensional magnitude. To evaluate the semantic closeness between two vectors, we can apply the basic rules of linear algebra such as computing the Euclidean distance the vectors. Some works already published on this subject showed that the level of objectivity of this semantic metric was close to the judgement of real human users [LAN99]. Our goal is to study the temporal evolution of these characterised magnitudes.

Context

The study is based on the proxy cache architecture named CACTUS and deployed on the Norman site of France Telecom R&D at Caen. This architecture is part of the MOLECULE project that regroups middle term studies on World Wide Web replication systems (caches, mirrors, CDNs, etc).

The four CACTUS caches are first level proxies and unsatisfied requests are then forwarded to higher level caches on a distant site of France Telecom. Caches used in the scope of this study regroup more than 200 workstations. So, users represent many communities of various interests: telephony, security, smart card, web, as well as of many professional profiles: telecom engineers, secretaries, managers, technicians, trainees. Although the research centre main activities are related to the new technologies, we can consider its population quite typical of a future medium size company in next ten years (in terms of web traffic generated or internal organisation concerning Internet).

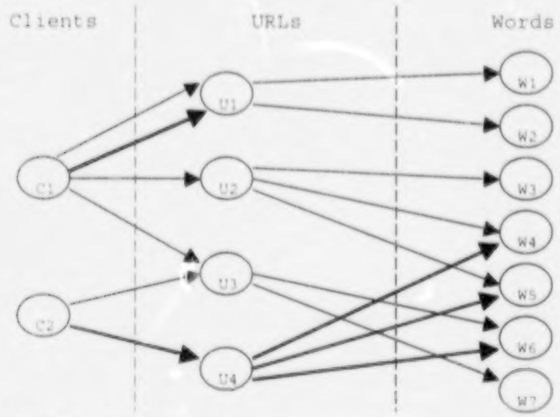

Figure 1

We use proxy log files to record in a database all web traffic. At the same time we make a semantic analysis of the viewed pages. We may use a graph to represent our knowledge database, as shown in figure 1.

Circles stand for clients, URLs or words, and have a unique reference, while arcs stand for links between clients and URLs or between URLs and words. Each arc has a weight, which is not mentioned. Thus for client C1 one notes it has consulted U1 (n times) which contains words W1 and W2 (with some weights). In figure 1, the bold lines represent information gathered on the second day of the experiment.

The preceding graph allows us to associate each client with a characteristic vector. The coordinates of the vector are weight of the words W1, W2, ... Different types of profiles can be obtained from the graph, but we use only the ones described in [LAN99b]. So we obtain vectors in the base formed by the analysed words.

Study of user profile variations

We just saw that a user profile is directly computed from its web traffic. Now we are going to study the link between the profile and the user traffic. Two diagram curves are used.

- the distance between a short term profile and a long term profiles,
- and the distance between a user profile and the group profiles

Time evolution between short and long term profile show us the level of thematic distance between daily user centre of interest and background ones. A horizontal line shows that the user visits every day the same web sites. An upward line tends to show that user focuses on subjects that diverge from its passed centres of interests. This distance trends all the more fast that curve slope is significant. A downward line shows that the user centres of interests tends to stabilise after a period of divergence. An erratic curve shows that the user has very different centres of interests in time. The line is all the more erratic that it takes into account short term evolution.

Comparing user profile evolution and group profile evolution allows us to identify users with centres of interests close or far from those of group. Following Fig 2 and fig 3 show two users with opposite behaviour patterns. One has his centres of interests close to those of the group. The other user does the opposite.

Following Fig 4 and fig 5 show the evolution between short and long term profiles. The first user tends to have his distance between punctual centres of interests and background ones increasing in the time while the distance of the second user decrease in the same time.

Undergoing works are going to allow us to include these profile evolutions for huge groups and to evaluate possible underlying laws.

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Team, Troop, Gang & Crowd: Collaborative Work in Distance Education

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1 Introduction

The Internet has become a melting pot where most traditional media, such as television, telephone and newspaper has merged and collided, resulting in fruitful combinations and new functionality (Braa et al. 2000). From the perspective of Distance Education this means a technological platform with support for dynamic distribution and organisation of hypermedia material, and support for flexible interaction. These potential effects are, according to Sproull and Kiesler (91), oriented towards enhanced efficiency. They proceed with the argument that new technology must also be understood in terms of longitudinal effects, affecting the social systems where it is adopted. And indeed, the perhaps most important outcome from using the Internet in Distance Education, is the social dimension it has introduced. This paper addresses the issue of *how* students organise, perform and perceive their work individually and collectively, and how can these issues be related to their use of ICT? The object of the study was a distance education project in Sweden, involving 6 learning centres in the vicinity of the course providing University. Weekly videoconference sessions and a web-tool (DisCo) supported interaction within the community (Svensson 98). The study involved interviews with 13 students and study-diaries from 14 additional students, aimed at exploring activities and reflections on their studies as well as co-ordination, communication and collaboration processes. Marton and Säljö (84) and Ramsden (92) argue that the ways in which students interact can be related to how and what they learn. They discuss the notion of *approaches to learning* (see Ramsden, 92, pp 39-66). This should be perceived as a situational phenomenon, influenced by a complex web of contextual factors, e.g. course design, methods for teaching and examination etc. There are two approaches to *what* students learn, (ibid.). The *deep approach* is oriented towards understanding and the *surface approach* is where students are occupied with memorising facts. This is in turn related to *how* they learn. The *atomistic approach* implies focusing on fragmentised parts without attempts to relate them to one another, which is contrasted by the *holistic approach*. These situated approaches are also connected to *orientation to studying*, e.g. a generic preferred strategy used by a student based on experiences from previous learning situations. Ramsden (92) presents four such orientations: (1) *meaning orientation*: Student has a deep-holistic approach and learns for the sake of learning. (2) *reproducing orientation*: Student focuses on memorising and avoids work that is not mandatory. (3) *strategic orientation*: Students seeks for clues to what will be assessed, motivated by hope for success. (4*) non-academic orientations*: Student organises work poorly, is not engaged, cynical and frustrated.

2 Results

The various groups differs with respect to whether the work is oriented towards an individual or a social focus. The individual approach is characterised by division of labour, whereas groups with a social approach have focused collaboration as the preferred strategy of organisation (Gaver, 91). Furthermore, there are clear differences regarding to what extent the members of the groups adopts diversified roles. Some groups were highly structured and characterised by their members having different and well-defined responsibilities. In other groups all members appeared to have equal roles and status. Contrasting these variables in a 2 by 2 matrix (Table 1) result in four metaphorical group-types, that should not be perceived as static labels attached neither to individuals or groups, but merely as possible ways to organise collaborative activities in connection with a specific task.

	Individual	**Social**
Different roles	1.Troop	2. Team
Equal roles	3. Crowd	4. Gang

Table 1: Group types

(1) Troop: Assignments where group work is required are approached with division of labour as the dominating strategy. The contribution of each member is subsequently merged in to a homogeneous product. The troop has one or two members functioning as co-ordinators with responsibility for managing progress. Members of a Troop uses ICT primarily for co-ordinating group activities, such as distributing documents, checking the status of fellow group-members. (2) ***Team***: The differentiated roles within a Team are related to variations in engagement and level of expertise. This group-type has a leader or a core of leaders, which organises and supervises activities, primarily organized as focused face-2-face collaboration. ICT is used for communication and for supporting general awareness, and questions to teachers is submitted by the group, rather than by individuals. (3) ***Crowd***: A collection of individualists that deconstructs all their group assignment. Most work is done from home, and little resources are spent on co-ordination and fitting the pieces together. The use of ICT is restricted to individual interaction with teachers and a minimum of co-ordination with other group-members. (4) ***Gang***: A democratic structure, where all members are equal and nearly all group tasks are done in focused collaboration. Individual tasks are mostly done together except from literature studies on evenings and weekends. ICT is used for community maintenance but seldom for communication with teachers.

3 Discussion

It is tempting to connect the group-types to a matching approach to learning (Marton & Säljö, 84) and study orientation (Ramsden, 84). Since the approach a certain individual adopts, by definition, is situational and strongly dependent on the characteristics of each task, it is hard to find substantial empirical evidence to confirm a connection between group-types and approaches to learning. Instead the data should be interpreted as expressions of the study orientation used by a certain individual. Applying these concepts to observed group-types result in a good match between *meaning orientation* and the Gang. Both concepts include active interaction, engagement, satisfaction and a holistic approach. The *non-academic orientation* corresponds to the low level of engagement and satisfaction of a Crowd. It is not equally obvious how the *strategic* and reproducing orientations respond to the group-types. There are examples in the case study, where a Troop, performs according to a reproducing orientation, with a tendency to delimit their work, not to exceed the demands of the task in question. In other cases, a well performing Troop focuses on producing a high quality product at the lowest cost. Work is goal-oriented and set on good grades, which is more coherent with the strategic orientation. The Teams are most ambivalent with respect to their study orientation. Some Teams appear to have a strategic orientation, but most of the observed Teams can not be said to have one shared study-orientation for all members. Perhaps these Teams are better perceived as consisting of two groups? The core of engaged leaders, functioning as a miniature gang with a holistic approach, while the remaining members resembles an attached crowd, sometimes not even present at group activities. The ICT is used within various groups is coherent with the collaborative levels it is supposed to support. Division of labour calls for co-ordination of files and tasks, focused collaboration is aligned with communication through email and chat. When contrasting the way ICT is used to communicate with teachers with differences in approaches to learning, it seams as though the deep-holistic approaches of Gangs and (the core of) Teams, are connected with low tendency to use IT for interacting with teachers regarding problems and questions concerning the subject matter. Instead most problems are solved through discussions within the groups. To email questions to a teacher is considered the last option when having difficulties completing a task. Such email are more frequently used in individually oriented groups with a higher tendency to a surface-atomistic approach. This implies that teachers should regard it as comforting when they hear nothing from the students, and start getting worried about the quality of learning when the email starts piling up. Maybe the evidence to back this conclusion is not sufficiently convincing, and it will be up to further research to confirm or falsify this suggestion.

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Turning Chaos into Order:
A Critical Evaluation of Web-Based Technologies

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Abstract: Changing distance education technologies (DET) tend to be associated with innovation, creativity, and massive capital gain; however little has been discussed about the other side of this hi-tech reality: chaos! In academia, for instance, US institutions adopt different newborn distance learning technologies believing in its massive potentials and expecting ultimate solutions to all its unprecedented challenges. However, the many do not seem to have the necessary tools to identify, compare, and contrast these net-based technologies. At Jackson State University researchers share their research progress in this paper and hope to bring some order to a chaotic proliferation of web-based DETs.

Introduction

The world of computing is witnessing chaos of innovation and the birth of new net-based technologies that claim to be the answer to all academic challenges anywhere and at anytime! Today, institutions of higher education can have the choice of mixing and matching different delivery methods in a single distance education course—that may include one or more of the following modalities: asynchronous, synchronous, real-time, or self-regulated collaboration. In today's fast changing economy, finding new ways that are both effective and creative in reaching learners at a distance is an important survival essential to the competitiveness of an organization. Corporate as well as public institutions are turning to the Internet to help them survive the game of competition to keep up with the digital change. However, many hi-tech DETs furiously roam the global world in all possible directions without any purposeful limitations or authentic validation of any kind! Competitive organizations face the challenge of delivering information, courses, and instructional systems to learners despite their diverse learning styles and needs. In addition, the management of these learning systems and its delivery methods and mechanisms while attempting to be both effective and creative, are tasks of a great risk to both the sender and the receiver of such an innovative net-based learning environment.

Distance Learning Technology: current state of chaos!

Recent publications in the area of distance education are numerous and none seem to disagree that US institutions of higher education as well as corporate America are witnessing a transparent explosion of net-based distance education. Proliferation of instructional materials, courses, and training programs are on the rise due to the increased number of online learners, decentralized customers and employees. However, despite the gradual but speedy incline offerings of online courses, confusion and doubt about how well these net-based technologies will best serve the purpose of learning is still a controversial debate that is gaining momentum.

And, despite the DETs popularity as powerful delivery systems that are the force behind reaching students, employees, and customers anywhere and at anytime, many still question their learning delivery effectiveness. And if they can equally stand to the face-to-face learning delivery and methods used in a traditional classroom or place of work. On the other hand, no one, however, denies that DETs have made it possible to overcome challenging obstacles of distance for distance learners to accommodate for their unique learning needs. DETs powerful features such as electronic mail, net-meetings, chat rooms, and live interactive video conferencing help bring traditional classroom reality to students at far distances (Harasim, Hiltz, Teles, & Turoff, 1995; Hsu, S., Oge, M., Hamza, M. K., & Alhalabi, B., September, 1999; Hazari, 1999).

The advances of these well-marketed, newly invented DETs are born at an accelerating rate giving births to new promises and building a world of truth and a shadow of myths! However, one must ask," what is effective and what is not, and which DET is suitable for one's learning environment that can meet the needs of the organization as well as the people it services?" For example, how can an administrator determine if the newly born net-based technology can meet his/her organization's challenge(s) or not—could that technology be another fad that might lead to massive capital losses and broken promises? Are net-based instructional systems designed to accommodate individual learning styles, and, if so, how can one determine if such an environment has been embedded into the instructional learning system? Can current DET in use do the job effectively, and is it open to incorporate any mix or combinations of different learning contents and different DET modalities?

At Jackson State University, observations gleaned from research and practical experiences encouraged the researchers from the college of computer science to further explore and examine the above-asked questions and explore the diverse DETs selection available in the market. Therefore, this research exploration was motivated by the following research synthesis in a pursuit for some authentic answers (Hamza, M. K., & Alhalabi, B., March, 1999; Haag, S., & Keen P., 1996; Hsu, S., Oge, M., Hamza, M. K., & Alhalabi, B., September, 1999; Hamza, M. K., March, 1999; Hara & Kling, 1999):

- Distance learning has become one of the fastest-growing areas in education; and
- A wide variety of distance learning solutions tend to exist and many different modalities tend to confuse the organization adapting the new and the promising; and
- Fast unprecedented growth has created chaos and confusion for the academic world and its leadership

Moreover, the research progressed as JSU researchers explored the possibilities of meeting the following challenging objectives:

- Identify different DETs for Internet-based distance education.
- Develop items and criteria for comparing and contrasting different technologies.
- Develop methodologies for experimentation based on sound research methodology (i.e., post-positivist research methodologies and instrumentation); and
- Methods of developing distance education courses based on the application and the delivery of net-based technologies; and

To pursue the above objectives, a survey exploring massive net-based technologies took place in which different DETs were identified and later analyzed from educational and technical standpoints. This report presents partial presentation of the criteria and the evaluation of these net-based technologies used in evaluating different DLTs-- in addition to the findings of this creative exploration (see Appendix A, which has some of the information about this evaluation process). The followings are the categorization of these DETs as emerged during this study:

DLT Categorization

Collaboration Tools: commercial tools that are most commonly used for synchronous exchange of information by institutions of higher education and organizations in the US:

  - Synchronous delivery: Tango, Netscape Collabra, MS Netmeeting, Java Collaborative Environment, and the like

Content Authoring: tend to be the most popular web authoring tools currently used by different institutions of higher education and organizations in the US:

- *General Website creation tools:* PageMill 2 (Adobe), HomePage (Claris), MS FrontPage, HTML, Javascript, Java, etc.
- *Specialized Web course development tools:* CourseInfo, WebCT, etc.
- *Multimedia authoring tools:* lecorder, Alive e-Show, Real Servers
- *Other miscellaneous tools:* Jackson State University Grading System (JSUG), Syracuse Grading System, Automation scripts, etc.

Content Servers: software applications used to deliver and serve content authoring

- Learning Space, TopClass, WebCT, ToolBookII, Virtual-U, Web Course in a Box, First Class, WebBoard, QuestionMark

Supporting Systems/Protocols: standard protocols used by most net-based technologies

- Mbone, RSVP, Multicasting, etc.

In addition, most software packages, when evaluated, seemed to have commonly shared features that offer better distance learning control, software affordances, and immediate needs by the user-- as claimed by the software manufacturers. The researchers followed a systematic process in evaluating each software by performing the following systematic steps:

The process

- Select/classify tool
- Download and install
- Study documentation
- Utilize for a course (real course if possible)
- Update criteria if necessary
- Evaluate and document results

Thus, the below criteria emerged based on the synthesis of all examined software capabilities provided by the software companies:

Criteria for Evaluating Content Servers

- **System Administration:** Access levels, Password and User name protection, System-wide accounts, Upload Roster files, Course backup, and System platform requirements.
- **Authoring Tools:** Select course components from a list, Bach mode content publishing, Criteria-based, content publishing, File upload from station to server, Multimedia content, Creating quizzes and exams, Global page design, Customized icons, Create content on CD-ROM, and Html knowledge is necessary.
- **Instructor Tools:** Instructor view of all courses, Hit count, Time-spent statistics, Chat room activity log, Database of questions, Automated test generation from database, Time limits for tests, Automated test grading, Course surveys, Creating groups, and Announcements.
- **Student Tools:** View grades, Compare grades to class summary, Multiple quiz attempts, Create study guides and add notes, Resume capability, Search course material, and Student view of all courses.

Features Used for Evaluating Collaborative Tools

- Chat; Bulletin board; White board; Email; Slides Presentation
- Shared Applications; White Board; Chat; Supported servers
- Shared Browser; Audio; Video; Student's feedback capability
- Security & level of instructor's control; Screen real estate management
- General ease of Use; General ease of learning; Acceptance in the market

Conclusion

JSU research will continue to help bring some authentic and validated criteria of evaluating different DETs to help educators make better and more efficient decisions when adapting and implementing a new distance education modality. Even though the rapid speed of technology tends to create chaos, however, JSU researchers strongly feel that this DET research will somehow bring some order and understanding to this chaotic process. Due to the guidelines and restrictions of this publication, it was not possible to present and share all emerged findings in this paper; however, the authors of this paper have included some information that might be useful to educators and administrators when adapting a new distance learning technology.

Appendix A
Description of criteria used in evaluating content servers

Administrator tools

Access Levels	The access level may fall under different categories. For Example: Administrator, Instructor, Designer, Student, Grader, etc.
Password and User name protection	Users authentication to access the server. Ex: Users access to server via user name and password.
System-wide accounts	Users provided with Global User name and Global password to view their registered course
Upload roster files	Batch mode account creation.
Course backup	Ability to backup course content. Ex: Server failure.
System platform requirements	Software and Hardware requirements to install content server. For Ex: Software : perl, JavaScript, Java server etc. Hardware:Memory etc.

Content Authoring

Select course components from a list	Allow to add and edit different course components to the Homepage. The Components are: Chat, calendar, Resume session, Course materilas, Student profile etc.
Batch mode content publishing	Ability to accumulate multiple changes and then publish these changes at once when done(avoid inconsistent state of the site due to partial modification.
Criteria-based content publishing	Allow to set time in advance so that users can access course, test ,quizzes on time
File management between station and server	Allow to upload course contents, questions, assignments etc from the station.
Multimedia content	Supporting audio and video file formats.
Creating quizzes and exams	Allow to create quizzes and exams
Global page design	Allow to reflect changes made to a particular

	webpage to all the users of the server
Customized icons	Allow to change icon appearance
Create content on CD-ROM	Allow to publish course content on CD-ROM.
Html Knowledge is necessary	HTML knowledge is necessary to design the course content.

Instructor Tools

Instructor view of all courses	Instructor ability to view all webcourse or few courses
Hit count	The Number of Times a course, Homepage etc has been visited.
Time-spent statistics	Time spent per student , per course, per exams, per quizzes etc.
Chat room activity log	User requests handled by the content server.
Database of questions	Questions which are created and stored in a database to create quizzes and exams.
Automated test generation from database	Test questions are created from the question database by the server automatically.
Time limits for tests	Instructor ability to set duration , and submission times of test, quizzes, etc.
Automated test grading	Capability of grading exams and quizzes taken by students.
Course surveys	Generate online surveys to evaluate effectiveness of course, instructor etc.
Creating groups	Ability to register students in groups for project, presentation etc.
Announcements	Announcement means, posting messages regarding exam dates, assignment due dates, presentation due dates etc.

Student Tools:

View Grades	Allow students to view grades of their homeworks, exams etc.
Compare grades to class summary	Student ability to compare his grades with class average.
Multiple quiz attempts	Allow students to attempt quiz more than one time.
Create study guides and add notes	Students ability to note down important points .
Resume capability	Student ability to resume a session from the point at which the session ended. For Ex: Stop solving an exam in the middle and comeback to the same question later.
Search course material	Allow students to search Glossary and full text of a course by using starting letter search, keyword search.
Student view of all courses	Allow student to view all course or only registered course when student access the web courses.

Collaboration Tools

Chat	Online interaction between users.

Bulletin board	Board where administrator, instructor and students can post messages regarding projects, assignments etc.
White Board	Board that Allow Multiple students to draw sketches and send text online..
Email	Interaction between students, administrator, and instructor through email.

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Using Technology in Strategic Planning to Foster Creativity

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Abstract: This work-in-progress project paper covers how technology is used for strategic planning at different levels of involvement for collaboration and network support. The guiding principle is to design a strategic plan using technology that would engage each stakeholder group in the most meaningful yet resource-efficient way to result in the highest quality recommendations. Information over the Internet is essential to understanding global perspectives and gathering up-to-date information. A search strategy is deployed to access information on creativity from CD-ROMs, library databases of books and journals, and the Internet. Strategies for selecting information from the abundant resources begin with discussing and deciding which criteria should be followed in the process. A search for alternatives/options is directed by the strategic planning objectives, which provide the essential direction and possibilities. Good decisions involve sufficient search for possibilities and fairness in the search of evidence.

In this project, technology plays an integral part in strategic planning to foster creativity in school. Singapore has invested heavily in a technology culture to anticipate future needs and fulfilling them. For instance, a system already exists using broad-band multipoint desk-top video conferencing. It is built on the SingaporeOne ATM island-wide network and the high speed ADSL line access provided by SingTel Magix. This infrastructure provides state-of-the-art support for the White Pine CU-SeeMe Meeting Point server and client software that enable interaction among people at different sites. At the same time, the education system in Singapore is focusing on critical and creative thinking.

Strategic Planning

Principals play a major role in strategic planning. Through their websites, principals clearly signal that it is well worth the time and energy invested. They need to strike a balance between the two extremes of wanting only the best and brightest to be involved and wanting everyone to discuss everything all the time. One effective method is to develop differentiated levels of involvement. A core strategic planning group consists of principals, key teachers and an external facilitator. A non-school person tends to be able to see patterns and recognize recurring themes with greater clarity than an insider. In addition, the facilitator brings experience and skill to lend both gravity and a sense of excitement to strategic planning. Together, the core group recommends and formulates ways to have an optimal mix of differential levels of involvement. The guiding principle is to design a strategic plan using technology that would engage each stakeholder group in the most meaningful yet resource-efficient way to result in the highest quality recommendations.

According to Sivan (1999), an important theme of a Knowledge Management system is that leaders come from all organization levels. Each monitors the progress of meeting clear objectives and adhering to the schedule. It is also important to synchronize this strategic planning with existing school cycles. For example, after a school appraisal and before action planning is believed to be an opportune time. Two reasons are the appraisal findings provide adequate data for the environmental scan required for strategic planning; and these ideas could be incorporated into the action plan that would be a part of the school appraisal system.

Leadership Styles and Empathy

Participants feel that leadership styles of principals rank top of the list followed by teachers' attitude towards successful strategic planning. One principal leads by learning with her staff, making them comfortable and recognizing their efforts. Sergiovanni (cited in Cheng 1995:10) states that "leadership is a very powerful force that can deeply influence the drive and commitment of teachers much more than the use of authority and management controls." Thiruvangadam (1994) recommended that more people-centered leadership is advocated to manage schools in Singapore. Some principals interviewed support his advocacy. Most of the principals believe that they should be people-oriented and interviews show that they are empathetic and encouraging. Teachers' perceptions of their principals' leadership styles show that principals understand and provide support in the integration of ideas in strategic planning.

Search and Select

Information over the Internet is essential to understanding global perspectives and gathering up-to-date information. A search strategy is deployed to access information on creativity from CD-ROMs, library databases of books and journals, and the Internet. In this way, project participants understand concepts and examine studies based on empirical data. Second, selection strategies are used to analyse and synthesise the accessed information. Participants categorise and determine which strategies and programmes could effectively be used in Singapore schools.

Strategies for selecting information from the abundant resources begin with discussing and deciding which criteria should be followed in the process. Participants are not willing to make "black-and-white distinctions" on the various options generated. They learned that convergent thinking leads to "satisficing" as opposed to "optimising" the number of options (Perkins 1994). They are encouraged to use divergent and creative thinking patterns to process viable options. The mental synergism that emerge from different members produce a wide range of guideline alternatives. A search for alternatives/options is directed by the strategic planning objectives, which provide the essential direction and possibilities. Good decisions involve sufficient search for possibilities and fairness in the search of evidence. Decision search strategies are shared among the core group. In evaluating all options, we try to find common areas from multiple frames of reference. The notion of building consensus is useful to accommodate diverse patterns of thinking.

Action Plan to Foster Creativity

Through technology, strategic planning to foster creativity is more efficient and focused. The planning is guided by key questions such as: What action needs to be taken? When? By Whom? The action plan includes (1) setting targets and measurable indicators for evaluation, (2) appointing an Implementation Team, and (3) evaluating the action plan. In conclusion, the preliminary results of strategic planning show that technology provides desired ways to foster creativity in schools. However, given the intensity of the commitment required, not all schools may be ready or willing to undertake such planning. For those schools that are, such planning done well could result in occasion for celebration. After all, we can use technology to connect people at different places and provide ways to search, select and collaborate together.

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DYNAMICS OF DESIGN AND DEVELOPMENT OF WEB-BASED ENTRY LEVEL ENGINEERING MECHANICS COURSE

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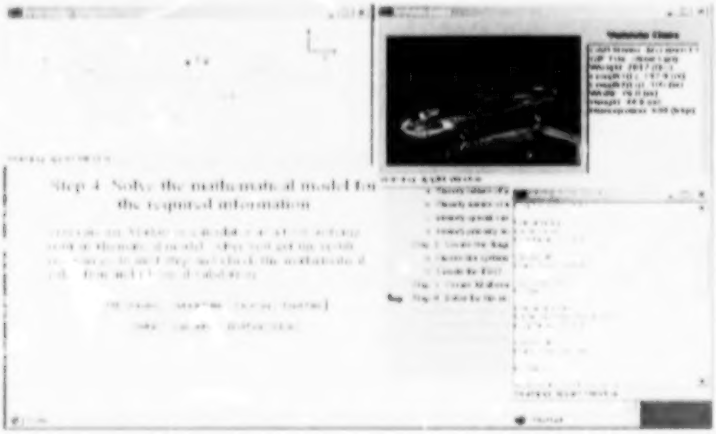
Abstract: Statics and Dynamics (mechanics) are introductory core-engineering courses taken by most of the undergraduate students in the Russ College of Engineering and Technology. Since Statics and Dynamics are one of the first two fundamental engineering courses in the curriculum, students often have difficulty with rigorous problem solving and with assessing whether or not their calculated results are physically meaningful. Statics and Dynamics are taught in separate quarters, and Statics is a pre-requisite to Dynamics. Though the two courses are related, students tend to forget what they learnt in the first course when they take the second course. It is very difficult for the instructor to demonstrate the connection between the two courses. By designing the two courses for the web as one course, the instructors plan to teach two quarters of Mechanics, with Statics and Dynamics being special cases of Mechanics. The web makes it easier to demonstrate the link between the concepts in the two courses as long as they are designed as an integrated Mechanics course instead of two individual courses.

Introduction Interactive Problem Solvers for Mechanics

The two courses (Statics and Dynamics) are being developed as a single web based course stretching across two quarters with heavy emphasis on Interactive Problem Solvers (IPS). Interactive problem solving is important both as a useful skill and as a means for teaching the important concepts in engineering design. But for true learning to take place (in the context of problem solving) the student must not be given the answer but must struggle and work through the solution step-by-step, receiving guidance only at the proper times. Therefore, the standard method of assigning and grading homework does not maximize student learning because it does not force the student to correctly solve every important problem and it does not provide immediate feedback. Eliminating partial credit and requiring students to continually rework and resubmit their homework until it is correct in order to receive credit for the work can increase student learning. This forced solution method is better for promoting student learning than the traditional grading method but it is very inefficient due to the amount of grading/guidance time necessary and the time lapse between the student's initial attempt at solving the problem and the feedback from the instructor. Often the student's calculated results are not physically realistic, but they are not aware of that until their homework problems are reviewed and returned. Also, since all students normally solve the same homework problems there is always the possibility that some students will copy the work of other students and will miss out on the learning experience provided by solving the problem. With computer based interactive problem solvers, the students can receive immediate feed back, each student can get a different problem to solve and the physically reality can be demonstrated graphically.

Description of the Mechanics Problem Solver

The concepts, methods and mathematics of Mechanics are very much dependent on the students visualizing the physics of the problem and understanding/interpreting the behavior of the solution (e.g. vectors, free-body diagrams, motion etc.). Most of the engineering applications related to Mechanics are truly three-dimensional. It is not easy for the instructor to construct an actual model of the problem in a classroom and demonstrate the physical phenomena (dynamics) of that model on a chalk-board. Using the tools available for the WWW (like Java and Java Beans and VRML), interactive problem solvers and tutorials were developed, were the students are provided with a situation (problem statement) and are required to solve that problem. The main problem may have several sub-problems and each sub-problem has several steps to obtain the final solution. The solution procedure might vary from student to student and thus the solution steps may change. For example if one wants to analyze a car moving on the road, the sub-problems could be car moving straight, downhill or on a circular path, on an icy road versus concrete road or gravel road and in each case the velocities and accelerations (mechanics) would be different. The current problem solver has several such sub-problems (currently, being expanded to more problems). The student also has a choice of selecting the Car model from a show room, and for each car the data/characteristics is different which makes it a unique problem and gives different output/results. In essence the student can work through the problem in many different ways selecting different solution schemes and variety of car models. The interactive tutorial has a problem tracker and keeps a log of all the steps performed, the number of tries made and the data input in those steps for the instructor to grade the problem and the student to retrieve it and correct his solution. Each step is an HTML form, which has multiple options to set up the problem, define the variables, define the free-body diagram, set up the equations and solve the problem (figure 1). Once the equations are solved a Java program graphically displays the "car" and the motion of the car based on the final results obtained after the equations were solved. At this time the student can visually determine whether his solution is correct or not, is the car spinning or toppling or moving as it should, based on the physics of the problem. In each of the forms the student gets two chances to select/define the right solution for that step, the hint button is activated after two tries and the student is forced to read the hint. After the third try the student is guided to a tutorial to reinforce the concepts related to that step, and the log file is e-mailed to the instructor and the student.



Step 4: Solve the mathematical model for the required information

Figure 1: Sample page for the Interactive Problem Solver

Conclusion

Thus the student can perform "build and break" scenarios on the web using interactive model building and learn the concepts of Statics and Dynamics associated with that model in an easy to use (friendly) environment. The students will be able to interactively change model parameters (e.g. force or dimensions or system) on the model and graphically view the effects of those changes by applying the principles of mechanics. The web course can be accessed at http://www.ent.ohiou.edu/~dynamics.

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DESIGN Of VIRTUAL LAB SCHEDULER And INFORMATION GATEWAY USING DATABASE And DYNAMIC HTML

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Abstract: This paper will discuss the relational database design process and database development process. Visual database tools in rapid development, tips and tricks of the design process, design of the Scheduler, authentication process used for the inventory administrator, basic security, configuration and maintenance of the web server and database server will be presented. In general, web design and web programming issues related to the "Virtual Lab" scheduler and information gateway will be discussed in detail including the advantages and disadvantages of all the tools used in this project.

Introduction

Databases are an excellent way to store information in a computer. They are much like a virtual filing cabinet. Whether one is collecting information about visitors to their web site, demographic data of the applicants, inventory, or organizing student records. The growth of the web has caused a drastic increase in the demand for databases and dynamic HTML. Universities are putting their course catalogs online, admission applications, registration forms, and other student information and providing interactive applications for students to review their registration information for the current quarter, check their grades etc. all with the use of databases. As the demand for information increases databases will continue to flourish. The relational database model is important to support services using complex relationships between objects and thus useful in data analysis and report generation.

The Virtual Lab

The "Virtual Lab" project is a web-based, graphical representation of the CITL's (Center for Innovation in Technology for Learning) multimedia computer lab. It provides detailed information about each of the lab computers, and allows users to schedule computers ahead of time. The Virtual Lab utilizes a *relational database* to store and retrieve information quickly and efficiently. The relational database model consists of a collection of tables (called relations) with relationship between tables being described by columns or attributes. The database is created in Microsoft Access and is stored on a Windows NT Server. This database management system, in an interactive and user friendly manner, allows each user to view the relevant data, provides appropriate security, maintains the data integrity, facilitates sharing of data, controls the redundancy, maintains consistency, tracks the software licenses, and balances the conflicting requirements. The inventory administrator can dynamically add and delete items in the inventory database using the web interface, without having to learn the Access database software or the design of the database. The Virtual Lab environment that actually allows users to interact with the database from the web is created in ColdFusion, a tool that allows for the rapid development of dynamic and interactive web-based applications. ColdFusion Markup Language (CFML) is an HTML-like tag-based scripting language that is processed by a ColdFusion server.

When a user accesses the Virtual Lab web site, it graphically displays the multimedia computer lab as an image map (figure 1). An image of each computer with its name is displayed on the first page so users can virtually "see" the lab. Clicking on any computer image will display the detailed information about that computer, including its name, processor type and speed, amount of RAM, amount of hard disk space, operating system, attached peripherals, installed software, a short description of the software including the category and capability of each software tool/package. This information will allow users to determine if the workstation has sufficient resources to meet their needs and which workstation they need to schedule/use. Since the inventory administrator can dynamically update the software and hardware changes in the database, and the "Virtual Lab" is directly accessing the same database, the user always has the most up to date information about the software, their versions (upgrades), and new resources added or removed.

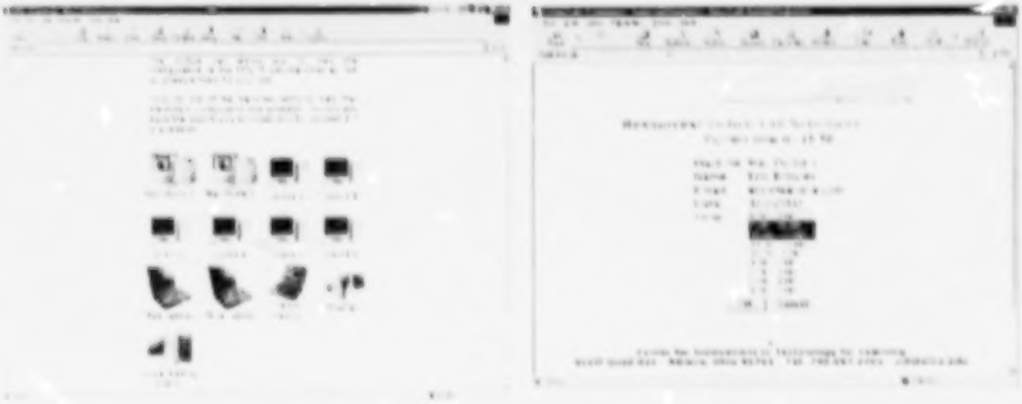

Figure 1 & 2: Image map of the Virtual Lab & Scheduler

While this information is great in assessing the sufficiency of a given machine, it is of little use unless a user can secure time to use the workstation. The Virtual Lab Scheduler (figure 2) allows a user to schedule any of the CITL lab machines through web. Times are scheduled in one-hour blocks, and users may schedule a workstation (or multiple workstations for group work) for as many hours as they require. In order to avoid conflicts, the Virtual Lab Scheduler does not allow users to schedule time that is past or that has already been scheduled. Once the lab is scheduled, an e-mail confirmation is automatically sent to the user and the lab administrator. The program also updates a printable calendar, which can be posted in the lab. This scheduling system provides users with assurance that they will be able to use the computer when they need it, and it helps the CITL staff manage the lab. The scheduler was developed using JavaScript and ColdFusion Studio.

Conclusion and Future Work

The Virtual Lab project has been successful in developing a web based computer lab information system, based on the most accurate inventory and upgrades to the workstations. The web-based scheduler will aid users in planning their work schedule efficiently by reserving the multimedia workstation in advance. The users can save time by checking the availability of the workstation before walking or driving down to the computer lab.

Currently, the Virtual Lab projected is being expanded to incorporate short web-based tutorials on the software tools available on the workstation, which can be accessed directly from the Virtual Lab environment. In the next phase, we plan to create "Virtual Peripherals" to provide faculty and staff with hands-on experience to learn how to use the peripherals (e.g. digital camera, video camera, slide scanner, CD-writer, audio and video capture equipment, and audio/video editing equipment) in a virtual environment using VRML and Java. In future search capabilities will be added for multimedia software and hardware available in the lab, thus the user does not have to scan each workstation to find the necessary software and/or hardware for their project.

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Specifying the Next Generation Distance Education System

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The Problem

Since its inception, the instructional techniques and even the course content of distance education (DE) courses have been constrained by the speed and quality of student /instructor interaction. For the first hundred years, DE was limited by the speed that the local postal service could deliver correspondence lessons. For the past 20 years, two approaches, which use very different technologies, have competed to deliver DE: 1) audio conferencing and compressed video conferencing have been used for synchronous delivery, and 2) the Internet and its progeny, the World Wide Web have been used for asynchronous delivery. Both of these delivery mechanisms were distributed to rural DE users over the Plain Old Telephone System (POTS). The quality of audio/videoconference delivery was increased through multiplexing POTS circuits. Projects such as the Adaptive Multimedia Education Enabler (Montgomerie et al, 1998) would forecast student needs and then trickle multimedia material through low bandwidth networks to a remote server so that lessons would be available locally when the student needed them.

There are strong criticisms of these types of DE delivery in both the academic and popular literature. These criticisms are particularly strong with respect to the use of these technologies in K-12 education. For example, Steinberg (2000) discusses the use of the Internet to teach DE courses and reports that "of the 600 students in 28 states who enrolled in at least one of the company's online Advanced Placement courses in the last school year, two-thirds did not complete enough of the course work to take the final exam." He then relates the experiences of two students: one who dropped out because "he could not summon the stamina to continue" without a teacher standing in front of him, and another student who "finished the same course, but two weeks late, frustrated by countless technical glitches that often prevented him from logging onto the Web for hours."

Fortunately, the landscape of communication technology is changing. The convergence of voice and data technologies has been accompanied by political competitiveness to promise ubiquitous high bandwidth Internet delivery. The United States has invested heavily in the Next Generation Internet (NGI) or Internet II. Canada has countered by developing CA*Net III, a completely optical Internet backbone with speeds and capacity orders of magnitude higher than the NGI. Industry Canada is "considering a proposal to help kick-start a multi-billion capital project that would bring gigabit-speed Internet capabilities and fibre into every Canadian home by 2005" (Canadian Communications Network Letter, 1999). In our own province, Alberta Innovation and Science (2000) has issued a request for proposal to provide "Reasonably Priced high-speed access" of 10 MB to every school and 100 MB to every school jurisdiction office by March 31, 2003.

The Fort Vermilion School Division (FVSD), located in the remote, Northwest corner of Alberta, is larger than Denmark with a K-12 student population of approximately 3500 students. FVSD is a leader in the delivery of DE using both synchronous and asynchronous methods. The University of Alberta and the FVSD have formed a partnership to specify and implement a state of the art DE system that combines both synchronous and asynchronous delivery. We decided to take a radical approach: rather than design a DE system based up on bandwidth constraints, we chose to design it based upon the desired course content and delivery techniques, so that remote students would be provided with an educational experience comparable to or even better than that experienced by their peers in traditional, urban classrooms. We worked on the premise that the technology needed to meet our specification would be available at the time of implementation.

The Specification

Synchronous Delivery

A video classroom will be created in each of the five High Schools in the Jurisdiction and at the University of Alberta, which is located 800 km southeast of Fort Vermilion.

- Up to six classrooms may be connected at one time.
- A simple GUI will allow control of which classrooms are connected.
- Each classroom will contain a data projector to display a) the image of the instructor, b) a "split screen" image of the students at all the other classrooms, c) students at one particular classroom, or d) 3-dimensional images.
- Each classroom will contain a monitor so that the instructor may view students in remote classrooms.
- Each classroom will contain a large display interactive electronic whiteboard (e.g., SmartBoard™). Computer output, digitized images, and hand written comments on one board will be reproduced on connected boards.
- A simple GUI will allow either centralized or individualized control of displays in all classrooms.
- Instruction can originate from any classroom or from a remote instructor connected to the Internet.
- Video and audio will be "broadcast quality" (MPEG-2).
- A centralized video server will allow the storage and display of full-screen MPEG-2 streaming video.
- Each classroom will contain networked computers that can be used to drive the interactive electronic whiteboard, allow students to collaborate using workgroup software, access the video server, etc.

Asynchronous Delivery

Computers in the 17 schools and in students' homes will have authenticated connection to the FVSD network.

- FVSD will work with suppliers to make higher speed connections available to student homes.
- A simple GUI will allow students to access the different services available on the FVSD network.
- Students may use the same workgroup software on their home computers as in the classrooms.
- The FVSD network will be connected to the Internet, with authentication controlling different levels of access.
- The "important" streams from the synchronous lectures will be stored on the video-server.
- Students will be able to review the synchronous lectures from the video-server, with "VCR-type" control.
- Students will be able to communicate with each other, with the instructors, submit assignments, use Web-based discussion groups, access asynchronous courses (e.g., Web-based Instruction courses), etc.
- Parents will have a separate authentication on the FVSD network to allow them to communicate with teachers and school officials, use the Internet, take Adult education courses, etc.

Implementation

An examination of the current academic and vendor literature indicates that all the pieces for what we propose are available. We are currently working on funding and implementing the system. There are three big issues: 1) how do we stitch the various products together into an easy-to-use, integrated, delivery system, 2) how can we prepare teachers and students to use this system effectively, and 3) is this a cost effective way to deliver distance education?

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Integrated CAI System for Language Education

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Abstract: In recent years, research efforts have been directed toward the field of education. Our group has developed network-based CAI system for actual use in classes. Our system supports not only in-class instruction but also preparation and review of class. Especially, the contents to review the class are referred to as "Class Contents". It is composed of the class scenery and the blackboard data. The "Class Contents" are generated almost automatically. This function is characteristic of our system. This paper describes the integrated CAI system, which we have named "EDLIN"(Educational system Developed for Learning on Internet and intraNet).

1. Introduction

We have been constructing a groupware system which uses LAN in the classroom effectively. We think that the integration of preparation, the class, and the review are necessary for those purposes. For more effective learning, we have developed not only class supporting application but also the applications which students can use for self-study. We integrated these applications and the resultant system was named as "EDLIN System".

2. System Configuration

Fig.1 shows the system configuration of EDLIN. In class which uses the EDLIN system, the teacher uses one PC (Server), and also each student uses one PC (Client). In the class using the EDLIN system, the blackboard is not used and teacher can teach on screen of PC. In addition, this system has improved the effectiveness of study in the class by the cooperation with word/grammatical search engine application, practice application of Web-base, streaming system of contents for review, and the multi-media leaning material application "MUSE" that textbook had been made into electronic. All functions to improve student's effect of study are integrated, so EDLIN system is constructed as an integrated study support system.

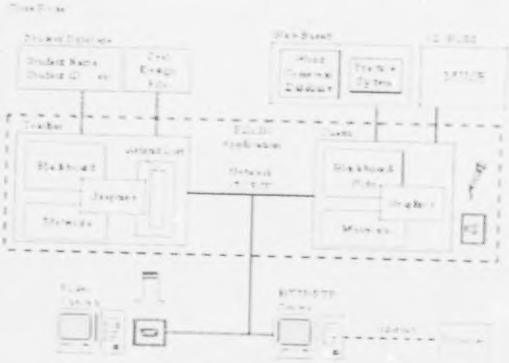

Fig.1 System Configuration of EDLIN

3. Features of the System

3.1 Communications Function

The teacher and the students can make communications freely by exchanging the text data in class using the EDLIN system. As the communications tools, the blackboard data, the mini test, and the chat and etc exist. Moreover, various files can be shared between the teacher and students. Distributing the teaching material files which teacher made, and collecting the report file which student made, becomes possible. Additionally, automatic student's attendance management function and pronunciation practice support function and etc are mounted.

3.2 Web-based Teaching Material System

WWW teaching material systems are the teaching material databases such as dictionary and grammatical teaching materials. Moreover, this system contains the study notebook system, which can record user's study history. In these systems, student's history of study are recorded to the database in WWW server. Because each student's study career using the WWW teaching material system can be saved, a better effect of study can be demonstrated by referring to it.

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3.3 Web-based Practice Quiz System

This system adopts the method; the location of words is arranged at random, and student permutes the word by drag & drop, and makes correct sentence. Therefore, students who study by using this system can interactively study the composition of German sentences. Moreover, the student can study using the relating teaching material system immediately, if he does not understand.

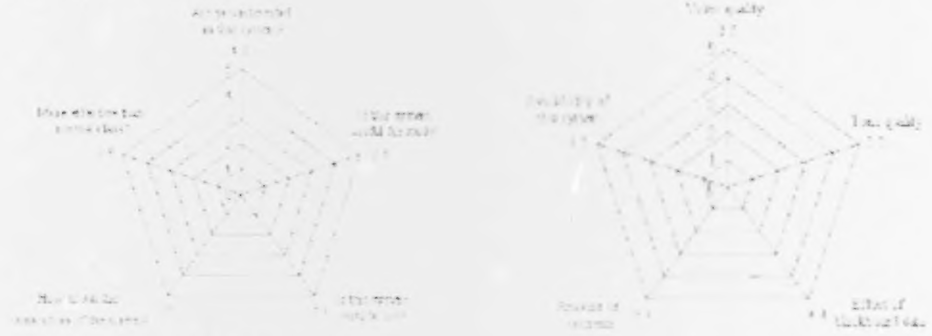
3.4 Class Contents Streaming

Though some existing systems can stream the "Class Contents", many of them are time-consuming for the edit of contents. In our system, however, contents are made almost automatically. All functions can be used as long as the World Wide Web browser and Real Player have been installed in the machine used.

The contents streamed by this system are three kinds: class video, voice, and blackboard data. There is a text file specification of the streaming distribution confidence named "Real Text" in Real System completely adopted this time. The synchronization of all contents can be taken by using SMIL file to integrate this Real text file and video file of the Real Media form. And we are using Real Basic Server G2 for the streaming environment for wiring of contents.

4. Evaluations and Consideration

We took the evaluation actually using the EDLIN system, in German language class. Moreover, this class was conversation specific. The questionnaire in five-stage format was executed about the EDLIN system. And, the questionnaire of five-stage form was individually executed about the "Class Contents" streaming. Fig.2 shows the result of these questionnaires.



About EDLIN System

About Class Contents Streaming

Fig.2 Result of Questionnaire

5. Summary

The questionnaire from teachers and students proved that the system was very effective. We were expecting that all students were able to attend the same quality lecture even in a big classroom. So we are glad to get students' understanding about this point.

As for the "Class Contents" streaming, we got the opinion that the system is very useful for the review of class lectures. Now the "Class Contents" files are streamed after class. In near future, we want to achieve it in real-time streaming.

The evaluation of the convenience was very high about the Web based application, because the users have been becoming familiar with the operation of the browser. Therefore, we will develop next version as Web-based system.

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Learning Web Communication Through the Experiments

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Abstract: In this paper I report about the understanding of undergraduate students of Sanno University in Japan regarding the web as a CMC (Computer-Mediated-Communication) tool. I also report an alternative method of learning about communication through the web. Through our experiments, I have found that student exposure to experience with and communication on the internet have shown to be very effective method, for evaluating the web as a CMC tool. My study also indicates that student structured individualized comparisons of the web to other types of media has a positive influence when evaluating CMC.

Understanding of the students before the class

Recently, the web is one of the most necessary tools for our communication and the situation with web communication through the web is now changing rapidly because we are changing that. That's why we should right now try to teach about web communication. I have been in charge of the class "Media Communication" for the past two years at Sanno University in Japan. The attendants of this class are sophomore and junior students, whose majors are management or information studies. According to the result of the questionnaire, for the students in this class, the web was the alternate media to television or magazines. Email was the only tool used for CMC.

Method

I designed this class with three major parts and in each part I tried some practical quantitative methods for analyses. That's because in the past, students responded that practice and analyses by themselves were very effective to learn about web communication. In this class the students learn the beginning of how to communicate effectively with others: how to receive the information, how to show the information and how to discuss with others on the web.

How we can receive information

The first part is studying how we can receive information through the web. Students in this class study about how we receive the many kinds of the information through face-to-face communication, communication through printed media, and communication through audio media: for example, radio, telephone and television. First, I prepare the text in many ways for this class: (1) without text, (2) the printed text, and (3) the text on the web (homepage). We evaluate by grading and comparing how we can receive the information through these texts. After this experiment, we've found that the web text itself is not as convenient as we expected before. For example, the method for access is being limited to in front of the computer and it's not as convenient as the printed text is. We can choose freely many links on the web and sometimes we miss the important information. On the other hand, we can edit the text on the web as we like: we can print it, edit it, put it on video and so on. For this same reason, the homepage text is also a very convenient text. After understanding this capability, we know that it's important to receive the text on the web as the pre-edited text and to edit it ourselves.

How we can send information

The second part is teaching how we can send the information through the web. Students in the class study about how we can send the many kinds of the information using tools as we did in the first part: through face-to-face communication, communication through printed media, and through the web. In this part "through the web" means via email, homepages, and discussion board on the web. Students are required to make short presentations (1) verbally, (2) with the printed material, (3) by email or discussion board on the web, or (4) on the web homepage. We evaluate each presentation with each other and compare how we can send the information through these presentations. In this experiment, after making the presentations, each presenter analyzes what the other students have understood about the presentation by quizzes them. After this experiment, we've found that there is no difference in difficulty between sending messages through the web and sending messages verbally. That's because message was seldom received as the presenters expected as it would be received. Of course some of the reasons depend on their design. We also compare some homepages and analyze which kinds of pages are good at sending the information effectively, not at showing it. For these experiments, we evaluate each presentation by grading, and that makes very clear the difference among the styles of the presentations and among some homepages. Of course again, it is also necessary to design these evaluations carefully.

How we can construct communication

The last part is studying about the features dealing with web communication discussion. Students in the class study about how we can construct communication with each other through different tools as we did in the previous parts: (1) through face-to-face communication, (2) communication through real bulletin board, (3) mailing list on the web, and through (4) the discussion board on the web. Each student should be involved in one of the groups corresponding to each tool. They are given the same topic – for example "How do we use the telephone? Is it different from the way our parents use it? " They are required to discuss with each other about this topic and reach some conclusions or ideas. We count how many ideas each group reaches, how long each discussion continues, how many members are involved, how often the members respond to others' speaking and so on. We also analyze what kind of speaking or response gets one to the conclusion or the idea. Through this experiment, we find that on the web, many members respond to others' messages very often, but they don't speak original messages, or reach conclusions or ideas. We also find that on the web a unique opinion or some similar responses trigger a conclusion, but with the other methods silence or no response triggers a conclusion. We also find that it is very important on the web to write sentences correctly as usual and that it does not help so much to use photographs or animation for our communication.

Conclusion

For the students in this class, the web was the alternate media to television or magazines. Email was the only tool used for CMC. Through the experiments reported in this paper, the students came to understand the aspects of the web as a CMC tool to some degree. With these practical or quantitative methods I mentioned above, we make clear the difference among the media types to some degree. One of the most important things that students learn is the attitude to always analyze the communication clearly. Through these analyses, students learn to focus on the communication itself.

As I mentioned above, the situation relating to web communication is now changing a lot and we can't decide what is the best way to do web communication. Because of its rapid change and its variety, we always need to understand and analyze the communication on the web. I think that the method I have reported in this paper is one of the alternative ways to understand web communication. I also think that we need to keep on analyzing and inventing communication on the web.

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Plugged In: Connecting with Students in an Online Learning Environment

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Abstract: A DHHS grant for over $1 million dollars provided the opportunity to develop an Internet option enabling registered nurses to obtain a bachelor's degree in nursing. A preponderance of literature addressing online teaching is available but most of it does not include practical suggestions for connecting students online to retain the human element in education. Numerous techniques were used to create a sensitive online faculty persona that encouraged trust in the learning environment. This environment resulted in the ability to engage students in highly interactive experiences. This presentation will provide suggested strategies for engaging students in an "Internet Learning Community"

Creating an Online Learning Community

The literature addressing online teaching includes few practical suggestions for connecting with students online to retain the human element in education. A DHHS grant for over $1 million dollars provided the opportunity to develop an Internet option enabling registered nurses to obtain a bachelor's degree in nursing. During redesign of the existing courses for online delivery, numerous techniques were used to create a sensitive online faculty persona, encouraging student trust in the learning environment. This environment resulted in the ability to engage students in highly interactive experiences. This presentation will provide strategies for creating an "Online Learning Community" where trust and risk-taking enhance the development of critical thinking skills. The evolution of critical thinking skills requires a safe environment. Students must feel free to take risks and challenge assumptions. Without a level of comfort between the student and the faculty member, students will be reticent to dispute ideas and stretch their thinking.

Comfort Level with Technology

Transitioning courses for online learning requires far more than a simple conversion to a web-based format. Lack of face-to-face contact with the learner requires new ways of thinking about how to connect with students. One of the first priorities for faculty is to assure that the technology does not get in the way of establishing this connection. "Comfort with technology is key to whether collaboration takes place." (Boettcher, & Conrad 1999). Students need to focus on the learning and not be distracted by the underlying technology. Therefore, faculty need to generate ways of assisting students to become comfortable with the delivery system. An important and useful method for achieving this goal is the development of a technical training manual. This manual should contain step-by-step instructions for activities that students will perform in the online course. These activities, or "boot camp challenges", should give students practice taking online quizzes, using the e-mail system to introduce themselves to their classmates, posting messages on a discussion board, discussing group assignments in the chat room, and uploading assignments to the course faculty, etc. These exercises will enable students to become familiar with and reasonably comfortable in the learning environment. Facilitating the use of the technology will prevent frustrating technical dilemmas that interfere with learning.

Personal Credibility

Next, faculty must consider the establishment of personal credibility. No where is an instructor more vulnerable to critique than in the online environment. Here, one's skill for effectively communicating in writing becomes transparent to all. Faculty must be able to view their teaching from the student's perspective. Attention to clarity, grammar, spelling, and punctuation are essential. Therefore, faculty who harshly criticize students' written work, when their own skills demand attention, may experience an adversarial relationship with students. Finally, the communication of complex concepts necessary for critical thinking requires clear, concise, yet innovative teaching strategies because faculty are not able to evaluate non-verbal clues to comprehension online. Simply posting PowerPoint content outlines used in traditional classroom presentations has little meaning in the online environment. Conversely, posting extensive lectures notes that do not contain material significantly different from the textbook is a time-consuming, boring approach. "A well designed distance course that has a focus on interactivity includes many topics for discussion, feedback from students as well as experts, and finally links to sources of pertinent information. Literature citations, journal articles and URLs are a

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few of the possibilities (Parker 1999). When developing content to foster interactivity, critique by a trusted peer can be invaluable. Students can also provide insight into the clarity of instruction through the addition of a course message board encouraging their questions and comments. A word of caution here is that faculty must remain objective when reading these suggestions to avoid misinterpretation of students' intentions. Tactfully requesting clarification can preserve the integrity of both parties and promote trust. Carlson and Repman remind us that, "The web may be a great medium for discovery learning, but there has to be substance for the student to discover!" (Carlson & Repman 2000).

Trust

Many factors influence the initiation and maintenance of trust in this environment. Assigning "busy work" is inappropriate in any learning environment but, it is particularly destructive in online education. The product of online learning is written. Students submit their work in the time intensive and laborious manner of a written format. When that product is perceived as "busy work", trust in the faculty member's expertise is quickly eroded. Students are less likely to become disgruntled with time spent in high-level, interactive activities that challenge their comprehension of materials through analysis, application, or synthesis strategies than with activities that require them to regurgitate what they have read. Collaboration is an integral component of higher education not only because it supports active learning, but also, because it is required for the workplace for which students are prepared. (Ben-Jacob, Levin, & Ben-Jacob 2000). Therefore, online faculty must become designers or managers of learning experiences, shifting the work of learning to the student. "The students become the center as interactive collaborative learners." (O'Leary 2000).

Flexibility

Flexibility is the hallmark of effective, interpersonal communication. Rigidity becomes very evident in online education. Faculty who are insensitive to subtle cues about student needs will struggle to establish a trusting relationship with their students. Awareness of students' work at the beginning of a course can provide clues to changes in behavior later on. These behavior changes can include decreased activity level, diminished quality, and delayed responses. Often this means that the faculty member will need to solicit student responses regarding the meaning of the new online behavior pattern. However, when students provide feedback, faculty must be flexible and willing to evaluate the validity of that input so that they can make meaningful adjustments in the course. Results of a study conducted by Indiana University Bloomington to profile the innovative teacher using technology concluded that all of the teachers who had changed their teaching with technology shared what one might call an "innovative personality". "They were willing to remain flexible and to modify their innovations as they received feedback from their students." In addition, they found that innovative teachers "liked changing things mid-stream to make them work better, not having to wait for the next time they teach the course." (Reimers, Rathbun, & Goodrum 1999). One must also keep in mind that it is easy to become so enthusiastic about the endless possibilities of activities for online instruction that one creates an overwhelming workload for the students. Identification of this factor demands the flexibility to adjust the assignments appropriately.

Risk Taking

Writing in the online environment creates feelings of vulnerability in both the students and faculty. Written communication is perceived as a more permanent form of self-exposure than is typical in the conversational environment of the traditional classroom. Thus, faculty need to take the lead in setting the example for risk-taking online. This is particularly true if your subject matter involves sensitive, personal expressions or examples to make a point. If faculty want students to apply learning to personal experiences as a demonstration of a concept under discussion, it can be invaluable for the faculty to provide the first example. Openness on the part of the faculty can facilitate honest communication from the students. Faculty leading the way in risk-taking activities enables the braver students to test the waters and others will follow.

Feedback

Important to the development of a connected relationship between the faculty and the student is the mechanism of feedback. In the traditional classroom, faculty are able to respond to students immediately. In the online environment, this response time is likely to be delayed. However, the delay should be minimized as much as possible so that each student perceives the faculty as truly committed to their learning. Timely review of materials supports student progress in a course. Long delays translate into student concerns about whether the faculty received the information or, if received, cared enough to review it. The literature suggests that the feedback time to online learners should not exceed 48 hours. The more connected the adult student feels to the learning situation and their faculty, the more effort they will put forth.

Tone of Written Communication

The final component that online faculty must consider in fostering trust is the tone of their written communication. Tone can be an elusive factor in written communication. However, it is a very important variable. How students interpret what faculty have written may be very different from the message that was intended. Most problems occur when faculty forget that it is imperative to be able to stand back from the message and view it from the students' perspective. This view relates not only to the content but also, perhaps more crucially, to the nature of the message. Sensitive critiques including attention to word choice, understanding student perspectives, openness to errors in thinking, and warmth are factors that reflect the online faculty persona. For example, an authoritative style can easily be communicated to and resented by adult students online resulting in the inhibition of trust. When this occurs, students begin to produce what they believe the faculty wants rather than challenging their own thought processes. On the other hand, an investment in the creation of an overall trusting atmosphere will allow the students to perceive the safety net required to step-out-of-the-box and work to improve their critical thinking skills. The use of humor, especially, if it is self-directed and not sarcastic, can be an effective method for engendering trust. "Humor can lighten the burden of the learning curve for both the student

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and faculty and can generate a felling of sincerity among those in the class. (Parker 1999) But, any method that communicates a non-judgmental, open approach will assist the students to view the faculty as human and trustworthy.

Characteristics of an Online Learning Community

Faculty who are successful in establishing an online learning community encourage student participation and discourage lurking behavior. Eisley (Eisley 1991) and Schmier (Schmier 1995) identified that learning is best accomplished when the learner is actively engaged in the process. Knowlton, et al (Knowlton, Knowlton, & Davis 2000) indicated that online discussions help students understand that there are real people that they are communicating with in cyberspace and that discussions facilitate the formation of an educational cyber-community of learners. Harasim (Harasim 1989) pointed out the benefit of knowledge building that occurs when "students explore issues, examine one another's arguments, agree, disagree and question positions. Collaboration contributes to higher order learning through cognitive restructuring or conflict resolution, in which new ways of understanding the material emerge as a result of contact with new or different perspectives. This type of online teaching requires emphasis on quality rather than efficiency. A high level of interactivity allows faculty to quickly identify when students are confused or need additional information and gain a greater understanding of individual students' performance abilities. As noted in the University of Illinois Faculty Seminar Report (University of Illinois 1999), "You get to know your students' minds, not just their faces". It must be remembered that "participation is not likely to happen unless it is deliberately planned and the faculty/moderator encourage it"(Boettcher & Conrad 1999). This format defines a learner-centered educational model where students operate in a more self-directed mode and have greater control of their own learning.

Conclusion

Clearly, many factors influence the initiation and maintenance of trust in the online environment. Greater discourse on this topic is needed in the literature. High level outcomes and the evolution of critical thinking remain educational challenges for all. Faculty contemplating teaching online must be cognizant of the need to prepare students for this new learning environment. Beyond technology preparation, faculty need to learn how to establish credibility with the students. Major factors that affect credibility include written communication skills, use of higher level teaching strategies, flexible approaches to learner concerns and needs, setting an example for risk-taking, timely feedback, and setting a tone that promotes open and honest interaction. These factors positively influence the development of mutual trust between the faculty and their students and the establishment of an "Online Learning Community".

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Collaborative Web Site Construction as an Instructional Tool

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Educational uses of the Internet have traditionally been limited to "showcasing" completed projects on school sites, or, as a source for locating information for research projects. We believe the Internet can be used as a tool for collaborative learning and educational development by posting works in progress and encouraging audience feedback and participation. By including digital discussion boards, cgi scripts, and other interactive features, students can expand their sense of audience and their sense of a learning community.

The Technology Outreach Project's Collaborative Learning Model

The Technology Outreach Project grew from a class I teach at North Carolina A&T State University; English 460-Technology and the Teaching of English. In this class, students are instructed in the ways in which technology can be incorporated in the areas of curriculum development and delivery, web-enhanced teaching, and distance learning. In the spring semester of 2000, ten students enrolled in my class. I divided these students into two groups. Each group consisted of four student mentors and one team leader. Team leaders interacted as public school student mentors but their primary responsibility was to assist in developing instructional materials, learning Blackboard 5, and the design of instructional web pages.

Forty students from two Title I public schools in Guilford Count participated in this phase of the Technology Outreach Project. Under the direction of Ms. Lisa Parker, an Advanced Learning Curriculum Development Specialist, two classes, one from Archer Elementary School and one from Montlieu Elementary School were organized by combining two very distinct student populations. At Archer Elementary School the class contained fourteen advanced learners and six at risk students. At Mont lieu Elementary School the class contained ten advanced learners and ten at risk students. Our objective in creating a diverse student population was to demonstrate our commitment to the belief that technology can and should be used to improve the education of all students. To insure the objectivity of project assessment, we did not disclose the status of any public school student-to-student mentors at A&T.

Web-Posting

One of the joint projects planned for students in the public schools was an inventors project. The original idea was for public school students to search specific Internet sites under the direction of their university mentor. The public school students would utilize Blackboard 5 virtual chat component as a means for discussing the content of various sites, write a brief summary or evaluation and e-mail their work to their mentor. From these exercises, it was hoped that a useful essay on an inventor or an invention could be constructed, combined with graphic images, and posted on the class web site. In short, we were utilizing common practice regarding web site posting of finished products.

In theory, our objectives were nothing outside the ordinary, but because of client side issues that demanded a variety of "work arounds" we were able to discover an option we had not previously considered. The virtual chat component of Blackboard required much stronger hardware than was available in the public school labs. The second problem that occurred was that even though the ability to send and receive e-mail was a required competency for public school students at the grade level we were working with, the school system had not provided students with e-mail addresses, and would not allow us to provide them for this project. A similar fear was also expressed regarding student's free and unsupervised use of the Internet. Although these are important concerns, it speaks to a series of issues beyond the scope of this paper. In our particular circumstances, it necessitated a major restructuring of our instructional methodology that led to an entirely different perspective on web posting.

Our solution was to utilize the digital discussion board in place of e-mail and virtual chat. Posting responses and various comments on the digital discussion board led to a continuing dialogue between mentors and students from both schools. Since these comments were posted for all participants to see, it created a running narrative of not only the brainstorming sessions leading up to project papers, but offered the opportunity to post larger sections of student papers for comments and suggestions by any mentor or student who chose to participate. Moving from posting on a digital discussion board to postings on a web site became necessary when papers were ready for the inclusion of graphics. By including graphics and transforming papers into HTML documents we were ready to build our web site according to our earlier model. However, we wanted to retain the interactive component of our project and we no longer viewed the audience as simply being a consumer of the message or site we had posted. We wanted to appeal to an audience that was not only viewer but potentially a collaborator, commentator, and composer in the construction of documents that exist in a continually evolving and developing state.

The most basic, and rather typical option would be to include an e-mail address on our web site for viewer responses. However, we soon discovered that viewers choosing to respond did so for a variety of reasons and consequently, the e-mail we received required a considerable amount of time deleting, sorting, and evaluating in terms of usefulness. Our solution was to borrow concepts from guest books and various other forms of cgi and java scripted forms we found on the Internet. By constructing our own scripts and forms for audience feedback, students were able to encourage more useful feedback, which could be used in future site development. To retain the free flow of open and unstructured responses students included an open text field for additional comments and questions.

Web posting works in progress expanded student's conception of the Internet from a location to post completed projects to a site that can utilize audience participation and collaboration in the construction of useful interactive instructional projects. In this phase of the Technology Outreach Project, we were able to expand student's sense of audience from a single reader to an unlimited audience, and increased their sense of learning community from a single classroom to a global community.

Teaching Synchronously and Asynchronously

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Abstract

New telecommunications technologies combined with distance education have allowed the school room walls to disappear. College across the world are experiments with presenting materials and supporting teaching by using the World Wide Web. This case study shows that students who participated in such a class rated their learning experience very high and that they thought the online environment helped them in expressing their ideas and opinions.

Introduction:

Many colleges and universities around the world have been using the World Wide Web to either support traditional face to face teaching or have been branching out into the actual delivery of courses online. This paper is a case study of a course that was taught one year in an online synchronous environment, and the next year the same course was taught using both synchronous and asynchronous environments. At the end of the semester the students were asked to complete a self assessment of learning.

Procedure

The course was designed to acquaint the student with the issues, both from a technologies point of view and a social point of view, that face modern society as we continue the move into the information age. The stated objectives included covering bandwidth problems, copyright laws, privacy issues, and social and economic access to technology.

The course objectives lend themselves very well to a class being taught in a cyber environment. Not only did the students study these issues, they actually experienced them. Also, because this was an issues class it lent itself very well to an online delivery method. The synchronous delivery method chosen for this class in both years was a World Wide Web based chat room. A Web based chat environment is one where the participant keys in information in a dialogue box and then clicks a button to post or to read what others have posted. This environment differs from an automatic refresh Java based chat because the participant must actually interact with the screen to read. If the screen is not refreshed within a six minute period the student would 'time out' of the room and would have to enter again. There is also a table at the bottom of the page showing who is in the room and how long it has been since that person refreshed his her screen.

The asynchronous delivery system used was Lotus Learning Space. Learning Space is quickly becoming a leader in online delivery of educational material. During the second year this course was taught, students had their synchronous interaction time cut in half and were required to participate in the LLS bulletin board. They were given the assignment to read the New York Times Cybertimes on a weekly basis and to comment on the articles. Since there was no way to know what was going to be covered in the Times it was expected that students would focus on articles with a subject matter that interested them. The assignment was to post a reaction to a minimum of one article a week, and to respond to a minimum of two postings from fellow students.

The synchronous chat sessions were for the most part very lively and engaging. This, however, depended heavily on the invited guest 'expert'. One week the 'expert' was a highly technical type and the students had a difficult time engaging him in a conversation. The second year, the synchronous sessions were also interrupted at random times during the semester by one or more students logging on under assumed names and disrupting the class. The incidents were so disruptive, at one point, that the invited guest (who'd participated the year before and had asked to come back) wrote a letter expressing his concern and asking not to participate in the future.

The asynchronous sessions were not as engaging as the chatroom sessions. Most students waited until the very last minute to post their original comments leaving little or no time for any discussion. The discussion never approached the level of interaction that was present in the synchronous environment. Even when student were commenting on another students posting it turned into more of a mini essay where the student was stating his/her own views and not commenting at all on what had been previously written. The bulletin board also suffered from a surfeit of 'me too' responses.

Results

At the end of the semester the students and instructor met face to face for the second time. During this face to face meeting, there was a discussion about the semester and the method of course delivery.

The comments returned on this self assessment support the literature that says that students who communicate in a cyber environment bond with each other in ways that students in a traditional classroom don't experience (Baym, 1995). One student wrote, *"Because we had to work in groups and not be able to meet, we had to solve problems our own way."* This sentiment was echoed by another, *"Not being able to meet face to face, adjusting to our limitations, was the only way to solve [problems]."* Another response to the question about problem solving a student addressed the disruptive elements in class with the following comment, *"I had to deal with a couple of individuals that I honestly would have preferred not to."*

Students also felt that they were more active learners in a cyber environment. *"It's not memorization, you learn to have a mind of your own. Kinda gets a perspective for what you should do/get out of classes like this one."* They even took this active learning to branch out and use online resources in other ways. *"I felt because of the class and its content I always had the desire to explore new avenues on the Internet."* One student summed it up with, *"I found that I was much more prepared for this class than traditional ones. The readings were easy to find and discuss with my classmates."*

The use of online communication both synchronously and asynchronously has also been shown to 'level the playing field' (Baron, 1984). And that it can reduce the distance between teacher and learner . Student feedback also supported this. *"It's so much easier to talk even if it is required, the chat room didn't hold the same pressure as a 'classroom' holds". "Online it was easy to discuss ideas in a variety of ways with a great number of people." "It made the teacher more of an equal, instead of an authority figure. It made it easier to express myself."*

Conclusions

The grades fell on a normal curve. This supports the research that says that motivated students learn from any medium if it is competently used and adapted to their needs (Schramm, 1977; Hoko, 1986; Romiszowski, 1988). The difference that the instructor noticed was the level of student/student interaction in the synchronous and asynchronous environments. Students seemed genuinely interested in the material and as evidenced by their comments on the self assessment instrument they enjoyed the way the course was presented and thought that they had been more in control of the learning experience. The differences in the level of student satisfaction between the two years data was collected can be attributed to some unhappiness with LLS as a delivery system. There were numerous problems with the LLS server and students were quite frustrated at times. There were also the problems of disruptive students in the synchronous chat sessions that led to some dissatisfaction. On the whole, however, students were pleased with the opportunity to participate in a learning environment that was different from traditional face to face.

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From Videoconferencing to Webcasting

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Abstract: Over the past two years, one of the most focused dental videoconferencing studies has been taking place between the London Dental Schools (Guy's, King's and St.Thomas's Hospitals, The Eastman Dental Institute, and the Royal London Hospital) and General Dental Practitioners (GDP) at eight postgraduate centres situated at least one hour's traveling time from London. Feedback from the evaluation and the experience of the project initiators has led to an extension of the project to explore webcasting as an alternative or even substitute for videoconferencing.

Videoconferencing Project

PROVIDENT (Postgraduate Regional On-line Videoconferencing in Dentistry) has been one of the most extensive dental videoconferencing studies undertaken to date. 40 separate videoconferences took place (10 from each dental School) during the one year period of the investigation. All postgraduate centres were supplied with identical PC based, full screen equipment which used ISDN 2 (128Kbits). Each transmission took the form of a small group seminar on a variety of clinical topics, covering most dental specialties. An independent evaluation involving the use of standardised questionnaires for both presenters and "students", telephone interviews and video-recordings of the sessions was carried out by an investigator from the Open University. Both structures and open questions relating to educational, technical and presentational issues were posed.

Results of the videoconferencing project showed that while participants welcomed the reduction in travel to the London teaching hospitals, the real benefits of flexible Continuing Professional Development (CPD) would only be realised if the dentists could access the courses from their practice/office (and even from their home).

Webcasting Trials

Webcasting obviates the need for relatively expensive and complex videoconferencing equipment and allows everyone with an Internet connection on contemporary home PC's to receive videostreamed transmissions. Indeed, additional visual aids such as Powerpoint™ slides can also appear on the same screen and interactivity can be facilitated by the use of a chat box (Figure 1). The aim of these trials was to construct models of best practice in the use of video media as a means of facilitating the CPD of GDP's. In this case webcasting was accessed singly and in parallel with videoconferencing using different teaching scenarios across different platforms (LAN and Internet). The same teaching material and lecturer were used in each case. 'Medical Emergencies' was the topic chosen as it has to be regularly revised by all practitioners. The evaluation strategy was similar to that used in PROVIDENT.

Results so far have been very positive. Apart from bandwidth restrictions which limited the number of recipients, the webcast was received in Europe, USA and Australia. The students particularly enjoyed the chat box and the personalisation window of the lecturer. The more complex webcast was much preferred for clarity and interactivity.

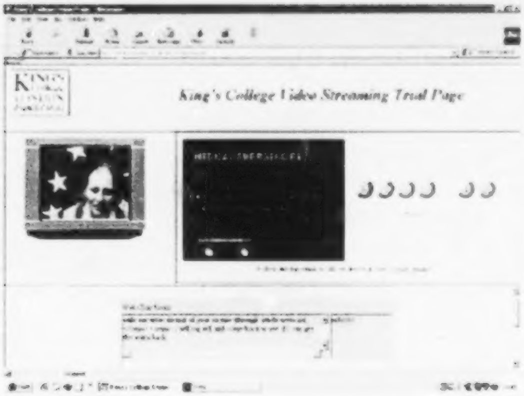

Figure 1. Screenshot of 3 frame webcasting

Comparison of the Two Technologies

The cost structures underpinning videoconferencing and webcasting are very different. Videoconferencing requires significant upfront investment in equipment and relatively high ongoing call charges and bridge costs for multi-site conferencing. However, the time and effort for existing lecturers to adapt to this medium are relatively minor. Webcasting has much lower equipment costs (mostly transferred to participants in the form of PC's at home or in the practice or both), but potentially higher academic inputs are necessary to embed webcasting into a distance teaching model with course content on the web and webcasting used interactively in a seminar mode.

The main technical problem encountered in webcasting was the limited bandwidth shared amongst the participants. This meant annoying interruptions and delays in receiving the webcast. However, the main difference between the two technologies was that the picture quality was better with conferencing and the audio better with webcasting. The added value of webcasting was the ability to review the recording on-demand with an active chat box.

Videoconferencing allowed a more interactive dialogue in the question and answer session but was more daunting for the students than webcasting. Despite using videoconferencing frequently in their training, students were still camera shy in front of their peers. The interaction was both verbal and physical (such as trying the Heimlich manoeuvre) but as it was instantaneous there was little time for reflection.

Conclusion

Videoconferencing works well in straight lectures as there is better picture quality and less effort for experienced lecturers in this medium. It is also relatively popular in a seminar setting and for clinical case studies. However, the technical set up times, the cost and limited sites available means that this was only used on special occasions.

Webcasting has more potential as an educational tool but requires more radical change both for lecturers and participants. The availability was restricted by bandwidth which was essentially only a temporary technical problem. However, the ability to receive multiple streams at home, work or globally, 'live' or 'on-demand' was far more flexible and cost effective. This seemed to suit the CPD needs of GDP's. Once webcasting is embedded in on-line accredited courses, it is likely to prove to be a very acceptable technology, indeed.

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Constructivist Education: Comparison of Traditional and Media Enhanced Approaches

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Abstract: In conjunction with recent technological and societal developments, there have been many educational advances resulting from reviews of the pedagogical value of conventional approaches to education. Many educationalists believe that current education systems are not equipping students with the necessary skills to enable them to cope with the modern world. It is argued that the traditional frameworks for education, which support a behaviourist approach to learning should be replaced by frameworks supporting constructivist learning environments. One highly effective example of constructivist theories in action is the Case Study Method of Teaching and Learning which, by exposing students to problems in a real-life context, bridges the gap between theory and practice, all the while in a protected environment. It has been suggested that this method can be further enhanced by the incorporation of new media into the delivery mechanism. Indeed, some would argue that it is only now possible, through the enabling medium of new technologies, to reform the educational system such that it supports these progressive theories of learning.

Background

The author undertook several experiments to determine the suitability of the application of new technologies to the Case Study Method of Teaching & Learning. The course under consideration for the purposes of these experiments was 'The Management of the Information Technology Infrastructure'. The students in question were in their final year of a part-time BSc degree programme in Information Systems, 1997-1998. The majority of them were adults, in full-time employment, seeking to improve their job prospects through the attainment of further academic qualifications. The course concerns itself with the management of the Information Systems (IS) function and infrastructure in its broadest sense, from internal data centre through end-user computing to outsourcing and facilities management. This course includes strategies and techniques for managing system planning, system development, technical support, operational support services and IS administrative services. To provide the students with both the theoretical background and practical experience required for a course of this nature poses a difficult challenge for the lecturers involved.

As a means of addressing this, the Case Study Method has been successfully deployed on this course for several years; the adult population of students in conjunction with the professional development aims of the course lend themselves particularly to this educational style. The validity of this choice could be evidenced by the heightened educational experience achieved by the students as perceived by the lecturers (up to this point in time, no experimental evidence had been recorded to verify this belief). Additionally, the lecturers in question generally created their own informal Case Studies, based on both personal experiences and/or fictional scenarios, as a means of delivering their course objectives. Thus the lecturers involved were fully au fait with the Method, from a facilitator's, designer's and administrator's perspective, albeit following the traditional paper-based/classroom approach, and hence, they were eminently suitable as a population for furthering the author's research of this particular approach. The students, and their lecturers, were exposed to both new media enhanced and traditional paper-based versions of the same case studies allowing extensive qualitative and quantitative research to be undertaken by the author into the viability and suitability of the technology within this context.

Method

The danger in creating any technology supported learning environment is that the development process will be technically driven rather then educationally focused. Also, courseware can be expensive to produce, in terms of both time and money. The approach taken here is to first empirically establish whether the educational value of case studies is improved or impaired by a change in the delivery mechanism with the view that further cognitive and technological elements can then be introduced, where appropriate, in a controlled fashion. Additionally, the opportunity was taken to garner and analyse the opinions of the participating students, courseware designers, case study facilitators and administrators on media enhanced learning environments.

To establish the comparative educational worth of a new media case study against a traditional paper-based one, two case studies were transformed into technology supported learning environments and deployed in a 'live' situation. A total of 104 students were involved in this experiment, 58 of whom experienced both a paper and a new media case study and a control group of 46 who were exposed to paper versions only. Two facilitators, in addition to 4 designers/administrators were also involved. The requirements of each case study, regardless of format, demanded work to be submitted for correction and thus the marks awarded could be analysed and implications for the delivery mechanism involved extrapolated.

Statistical Analysis/Questionnaires/Feedback

As previously stated the experimental approach taken here is to first empirically establish whether the educational value of case studies is improved or impaired by a change in the delivery mechanism. This was achieved by comparing the performance of a class of 104 students as they worked on two implementations of the same case study, traditional paper-based and a new media version. The marks awarded to the students at the end of the case study sessions were analysed, by the author, using a statistics software package (SPSS for Windows) with a confidence interval of 95%, to empirically determine the effectiveness of the delivery mechanisms.

More quantitative evidence was gathered by formally surveying the students after each of the case study sessions. The questionnaire was prepared by the author and tailored for each of the sessions to reflect the particular case study under consideration and then (for the final session) to enable a student comparison on the both case studies and mode of implementation. The questionnaire took 15-20 minutes to complete. A statistics software package (SPSS for Windows) was again employed, using a confidence interval of 95%, to translate the views of the students into statistical data.

The opinions and recommendation of the Designers/Creators, Lecturers/Facilitators, and Administrators involved with all of these experiments was also gathered. An informal method was employed; comments, notes, reviews etc. were collated and analysed for general trends.

Implications

Hence, an initial foray into the area of new media applied to the Case Study Method of Teaching and Learning has been undertaken. The results from these experiments support the supposition that web-enhanced courseware offers great potential to students and teachers alike with both groups enthusiastically recommending further work. The empirical evidence in the form of marks awarded to the students also bears this out. However, it was interesting that while half the members of the sample group felt that technology has the potential to provide them with a richer learning environment, they did warn against the injudicious introduction of the latest advents in technology. Being technically literate, they had the capacity to distinguish the form from the content and would not be overwhelmed, or inspired, by technical wizardry for its own sake; many students commented on the validity of face-to-face discussions and did not feel that technology could compete in this arena.

Image Quality Assessment in Web-Based 3D Computer Graphics

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Abstract: A number of Web Based 3DCG packages have been developed by individual companies for use over the Internet. These packages permit only a very limited exchange, given their proprietary nature. The user is constrained to the Web Based 3DCG package of a given company in order to create a 3DCG object. This meane using a transformation tool to transform a 3D object into a special file format. It is difficult to compare different Web Based 3DCG packages due to the special file formats used. In this paper we propose a method for an objective assessment of image quality for Web Based 3DCG.

Image Quality Assessment in Web-Based 3D Computer Graphics

There are two basic methods for assessing computer generated image. The first method is subjective, and the second is objective assessment. Subjective assessment means the human being sees an image and judges it's quality. This method depends upon the person who evaluates what is to be judged and may give an inconsistent assessment. To assess objectively means that the technique does not depend upon the person who performs the assessment: any one can follow the assessment procedure and obtain the same results. Therefore, we must use objective assessment methods, if we wish to obtain consistent image quality.

There are "real" and "pseudo" assessment methods for assessing objectively image quality for images used in Web Based 3D computer graphics. The "real" assessment method evaluates the Web Based 3DCG image (object) directly, while the "pseudo" evaluation method does so indirectly.

Since Web-based 3D computer graphics (3DCG) technology fuses Web technology (network technology) and general 3DCG technology, an object inside a scene behaves according to principles similar to those in general 3DCG. The object must be rendered by the rendering engine and then the scene is created. While rendering the object, the engine transforms the object into the polygon model, even if the object itself was made by "point-based model" or "surface-based model." 3DCG software must "know" the surface of the object precisely. To decide the lightness and darkness of the color of an object's surface, the direction the object's surface is facing is determined. A line can be drawn normal to the surface, once the rendering engine has determined this direction. This line is the straight line that meets a curve or curved surface at a right angle. This normal line is sufficient to show the direction of the whole surface. If information about the normal is available, the rendering engine can calculate the exact angle of the surface that corresponds to the direction of the source of light.

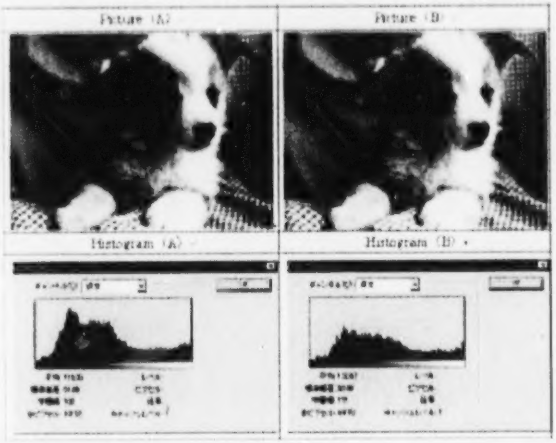
In the real world, most objects are composed, not of plane surfaces, but of various curved surfaces. Curved surfaces will require many normal lines on the surface of the object to show direction. Because for the rendering engine plane surface objects are easier to calculate than curved surface objects, many 3D software packages transform the curved surface into a polygon approximation immediately before rendering the object, even if the object was produced on the basis of the spline model or NURBS or some other modeling method. By transforming the curved surface into a polygonal approximation, the rendering engine is able to use one normal for each polygon.

Polygonal approximation requires many polygons if we want to create smooth curves and curved surface objects. However, this method can not express a completely smooth curve and curved-surface even if we use many polygons. If we want show an object as soon as possible, the surface of the object must be formed by using many polygons. Finally, 3DCG will generate a graphic image and output it to a frame buffer, but a Web-based 3DCG generated graphic image will be displayed on a Web page (screen). Web-based 3DCG is application of standard 3DCG technology, so when the scene is generated on Web Page with Web Based 3DCG, the rendering engine will decompose the object into its constituent polygons before processing it. If we can count the number of polygons that were decomposed by the rendering engine, then we can compare the quality of the images generated by Web Based 3DCG objectively. An object composed of many polygons is will appear smoother than does an composed of a lesser number of polygons.

Assessment of Web-based images poses a practical problem: today we can not know the real file format of individual Web Based 3DCG packages, because these are the property of individual private companies. If we can know the file format precisely, we shall know how the corresponding Web Based 3DCG rendering engine decomposes objects into polygons. Then we can create an image quality assessment and count the number of polygons. This tool may then be used to assess objectively different Web-based 3DCG images.

The method that counts the number of polygon evaluates picture quality objectively, which we may call a *real* assessment method, is difficult to implement. Therefore, a simpler technique, called *pseudo* assessment, may be used that evaluates the 2d projection of the 3D object.

Each pixel of the 2DCG image holds shading and spatial (coordinate) information. The geometrical distribution of the image shading shows information. It is the spatial information contained in the pixels that shows shading information and distribution, so if we can measure this information, we can evaluate the image quality objectively. One method that checks the shading information exerting influence on the image measures shading information at every each pixel displayed and calculates the pixel information and creates a histogram . If we calculate each pixel of the image, we can distinguish logically between images. However, if we only see the histogram, we can not judge image quality, whether it is good or bad. If we can beforehand gather several different several values at the time of the peak histogram, and use an assessment method based on ITU recommendation DSCQS Double Stimulus Continuous Quality Scale [1] [2] assigned to the tester, then we can judge image quality to determine which one is good or bad (For an example, see the Figure)



The monitor (CRT), by its very nature, is able to display only two dimensional images. Although in Web-based 3DCG an object has three dimensional information, the monitor can only display a two dimensions projection of the three dimensional object.. When Web-based 3DCG objects are displayed by utilizing the monitor and observed by the use, if the user does not perform some intrinsically three-dimensional operation on the object, the user will not perceive that object is in fact a three dimensional one. Therefore, we can regard a Web-based 3DCG object as a kind of two dimensions image, if we do not perform any 3D operation on that object. Therefore, a pseudo evaluation method to assess Web-based 3DCG image quality means using some method to capture Web based 3DCG images displayed on the monitor and evaluate the image using a usual two dimensional image evaluation method for assessing image quality. If we use this method, we can evaluate images produced by Web-based 3DCG objectively. However, this pseudo evaluation method evaluates the Web Based 3DCG object indirectly, so it is not evaluating the three dimensions object in a three dimensional condition. Moreover, this method judges the image quality objectively.

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http://www.strl.nhk.or.jp/publica/dayori/dayori99-02/doukou-j.html

Virtual Spaces Applied to Tele-Learning - an M^{2}COTS Approach

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Abstract: Today the university paradigm is changing. The university admission examination is difficult in Japan, and students study hard before entering university, but may forget what they learned in the process. Therefore, they enter the university exhausted and demotivated. The university must therefore create an environment that is interesting and stimulating for the students. We created an interesting environment that may be effective and attractive to students using an M^{2}COTS approach.

Introduction

The basic problem underlying the work reported in this paper is that of creating an attractive and effective classroom environment by the use of virtual spaces applied to tele-learning and an M^{2}COTS (mass-market commodity off the shelf) approach [9]. The technologies to be exploited in this endeavour include Internet-based videoconferencing, slideshow presentation and streaming technologies and, in future work, today's emerging wireless multimedia telephony. Overviews of tele-learning and web-based instruction may be found in Collis [5] and Khan [7]. Today's students have become customers who pay tuition to the university, in return for which the university provides access to expertise, knowledge and a learning environment. The university environment must be attractive to the potential students and must be effective in helping these students meet their aspirations and expectations, be these in their personal or professional lives Finley [6]. This principle applies both to undergraduate as well as graduate studies. In this study, the first goal is to design and exploit virtual spaces [1][10] in the experimental environment of tele-learning, whereas a secondary goal is to explore the new emerging university paradigm [2][4] using these virtual spaces. While the major concern of the authors is the design and software/hardware/network implementation of these virtual spaces, they have necessarily been obliged to consider human needs, capacities and limitations. Human factors considerations raised by D.A. Norman in his work on attractive design take on an all-important role in the authors' work [8].

The Study

The immediate purpose of this research is to examine the application of virtual spaces in tele-learning using an M^{2}COTS approach. To this end, standard off-the-shelf multimedia PC's, streaming, slide-show presentation, and videoconferencing hardware and software were used, with the University's FDDI intranet as backbone and LAN's used locally. The human elements were the professor and staff, that is, several assistants, including a translator, and students enrolled in the course. The occasion was a special lecture by the professor, who spoke in English, to the Japanese students, most of whom did not speak English (even though they manage to understand English well enough to appreciate American rock, rap and movies). The professor and one assistant remained in his laboratory, in which the streaming server was located, the students, another assistant and the translator were located in an auditorium located in another building. Auditorium equipment included several PC's for controlling the presentation (using presentation software), projector, microphones, cameras, and a set of television monitors located at convenient positions for the students to follow the presentation. This arrangement is what maybe called an "Internet/intranet/Web" connection and clearly can easily be extended and modified to cover greater distances and accommodate a wide variety of communication modalities.

The trial designed was for a special undergraduate lecture and the challenge was to create an interesting lecture that would overcome an attitude of disinterest on the part of the participating students ("this subject is not relevant to anything I am interested in, so why bother attending? And besides, the professor will give the lecture in English and I shall be totally bored. Anyhow, I sure would rather party than study!"). The motivation then was to create an attractive learning environment for the students using the elements mentioned above. The contents, namely an introduction to multimedia communications, were arranged in a way so as to attract and maintain the students' interest and to pique their imagination. The pedagogical aspects of this work are, of course, an entire field of endeavour in and of themselves and, in this case, an attempt was made merely to cast the contents in terms of subject matter familiar to the students. Therefore, this trial is referred to by us as the "Matrix" trial since we used the movie "Matrix" as a background prop to illustrate as well as entertain the students as the fundamental concepts of multimedia communications were presented. Primitive as our trial was, still it reflects much as current attitudes towards learning environments as described in a recent paper of Ben-Jacob, Levin and Ben-Jacob [3]

The experimental configuration used in this trial is described in Figure 1. As mentioned, an M2COTS approach was used, that is, all hardware and software products are freely available on the market place, usually at consumer affordable prices. Therefore, our equipment is not special: anyone may buy it just about anywhere, and it is not expensive. To the extent that all software and hardware conform to the same standards, various platforms may be used. The university intranet and laboratory networks made up the communications infrastructure. The university network is an FDDI campus network connection. Today one may use ADSL technology or other high bitrate technologies that serve well the bandwidth needs of multimedia applications. This gave an environment in which the presenter, from his laboratory, was able to use the presentation software and PC to present the slide-show in the auditorium, communicate to the students and the translator (who would translate after the professor made his remarks about a certain slide, almost as if commenting on what the professor had said about the contents of the slide), exchange comments with staff and students in the auditorium, control the streaming server for streamed demonstrations, and so on. Via the intranet-based videoconferencing system, the professor was able to see the students or any other part of the auditorium and the students were able to see the professor. The trial ran for sixty minutes followed by an on-site visit of the professor to the auditorium.

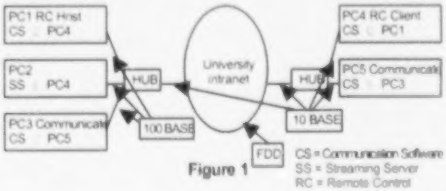

Figure 1

Conclusions

This trial showed the promise of using rather simple virtual spaces in tele-learning to create an attractive learning environment for (Japanese) students. A post-trial poll conducted with the participating students gave very favorable results. Though simple, this trial was far from simplistic. It showed, among other things, that with care, the very formidable English-Japanese language barrier can be overcome in a very effective way, that students, who are otherwise rather demotivated, can be enlivened and their interest piqued, and that they sensed a charm that is normally not present in their other courses.

All these results suggest that the approach taken to create an attractive learning environment is viable. For that reason, future trials are being planned involving larger groups of students, eventually using a remote university facility in a large city about 50 kms from the main university campus. At this time, wireless telephony has become enormously popular in Japan and wireless Internet connections are becoming commonplace. Later this year a multimedia wireless telephone will be marketed. In addition, more students are using laptop computers in their studies. We are looking therefore to creating virtual spaces using all these technologies both for real-time and off-line use, for example, in consulting video databases designed for the trials.

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Learning collaboratively in a Web based Environment

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Abstract: The internet has helped to remove the isolation of learning at a distance for off-campus students and enabled them to interact regularly with other learners and their teachers in virtual campus environments. The use of web based computer conferencing also provides the possibility of collaborative group learning in a way that has never been possible in distance education before. This paper describes a study that developed the findings of an earlier research study which found that interactive online group discussion was central to the learners' effective construction of new conceptual understandings. The social conversation of the online group provides the learner with a context and stimulus for thought construction and learning which contributes more to each learners' understanding than is possible individually.

The research study

This study was designed to investigate how the learning processes and learning outcomes of courses within a masters degree program focusing on distance education were affected by the use of computer conferencing. It developed the findings of an earlier research study into online collaborative learning (Stacey, 1999) which found that interactive online group discussion was central to the learners' effective construction of new conceptual understandings. The study researched: 1)how computer conferencing is used in teaching and learning as a dynamic environment for sharing ideas and constructing knowledge, 2) how the asynchronous, text-based nature of interacting through computer conferencing influences the way students write, reflect, communicate and learn, 3) how the collaborative learning environment affects the students' learning.

Participants were studying *Teaching and Learning with Computer Mediated Communication* which was developed in response to students' growing interest in the theory and practice of teaching in an online medium. They were required to share resources they have researched and evaluated through searching the World Wide Web, to moderate discussions about issues of online learning, and to work in collaborative groups for an assessed task on researching the theory and process of collaborative learning online. Data was gathered electronically using qualitative methods through archiving and analysing the online interaction of the students and by gathering students' perceptions and reflections on the effect the conferencing process has on their learning. Quantitative data was collected through analysis of the frequency and type of messages which occurred on the conferences as well as through analysis of final student results for the units. This paper will discuss the collaborative small group learning process of a subgroup of twenty participants (4 male, 16 female).

Methods of data collection were: 1) Through the FirstClass unit conferences, voluntary focus groups were requested to respond within an electronic conference which was established for the project. Questions about experiences learning online and reflections about online practice were posted in this area for student response during the semester. 2) Retrospective analysis of conference message archives is being used to analyse communication and learning processes. This involves calculation of frequency of use, size of messages and analysis of conference message content. 3) Stimulated recall techniques are being used by sending selected messages back to the students who have posted them to the conferences for their later reflection and response. 4) Analysis of relevant student comments within assignments in the unit. The assignments are designed to encourage reflection on the online teaching and learning process and are relevant to the focus of the research project. This paper reports on work in progress and will discuss the preliminary results gathered so far in this project with the conference presentation providing a full summation of the results.

Preliminary results

The students describe working harder than in other subjects learned at a distance as they are accountable to the group and engaged more with reading and reflection on a wider range of resources than they would have consulted alone. They are unable to just do the minimum for the assessment when they are asked to contribute to an ongoing discussion. Many described the motivation for learning that group communication provided as the group developed and they enjoyed the interaction which reduced their usual isolation in distance learning. The different perspectives provided by the different students was particularly seen as an advantage to their learning as it took them out of their own limited view of the subject (often with difficulty). Most students recognized the value of this although a few students elected to work independently on their assessment. The shared resource base was seen as a great advantage of this type of learning as web resources have increased to such an extent that a group process of research and commentary on web sites provided students with a much better resource base than they could find themselves.

Disadvantages identified were the increased time spent on the subject (though this was seen as an advantage by the teacher). However this was an element that the students usually saw as a choice and as a self management issue. Some distance students complained that they chose to work at a distance as they preferred their independence and the ability to work at their own pace and though they could see the advantages of the medium in their learning, these were factors that needed consideration. Two male students withdrew from the online collaboration and though one was caused by work pressure, the other preferred to work independently. The quality of his final assessment reflected the limited perspective of his engagement with the course.

The global capability of web based learning was demonstrated in the study with one very effective group having members in Korea, England, Melbourne and Alice Springs and another with two students in New Zealand and two in different states of Australia. The aspect of the need to communicate in a synchronous way was raised by all students and even the most widely dispersed groups were able to manage synchronous chat through use of the FirstClass client software chat facility. This seemed to enable them to establish social presence and group cohesion and is an important factor to be considered in establishing online courses.

Discussion

The earlier research study into postgraduate collaborative group learning (Stacey, 1999) which provided a theoretical framework for hypothesizing and developing this study had found that students' learning had been enhanced through the process of collaboration. Among the attributes of their social construction of knowledge were the sharing of the diverse perspectives of the group members, the clarification of ideas via group communication, the feedback to a learner's ideas provided by other group members, the process of seeking group solutions for problems and the sharing of resources within the group. These attributes were again reported by participants in this study as the basis of the learning they experienced collaboratively online.

The earlier study showed that collaborative behavior of an effective learning environment also provided socio-affective support that motivated learners. The friendly social conversation appeared to provide a group cohesiveness in the face of shared concerns. The cohesive groups enabled a democratic system of group management, responsibility and roles and collaborating together motivated students to study effectively. These findings were again replicated with students commenting on the breakdown of the isolation of distance learning. The participant-identified importance of synchronous communication as well as asynchronous online communication for establishing cohesive groups online draws into the discussion of social presence in computer conferencing as well as the discussion of the changing nature of distance education with a core of "an adaptive teaching and learning transaction" (Garrison, 2000, p. 13) enabled by interactive communication technologies. This study is adding to the understanding of that change.

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Clinical Reasoning Skills in the Pediatric Occupational Therapy Course

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Abstract: This paper describes a work in progress in which multimedia is integrated into classroom instruction with the goal of enhancing clinical reasoning skills among third year occupational therapy students. The integration of multimedia and problem-based learning is designed to create a clinical climate in the classroom. The goal is to provide additional opportunities to use learning materials, and to apply the skills and knowledge students need in evaluation, intervention planning, formulating treatment goals and objectives, and documentation.

Introduction

Current trends in occupational therapy education requires the movement away from the memorization of facts ("recipe approach") and toward an analysis, synthesis, and application of the data to provide excellent services to children with disabilities. Learning how to exercise clinical reasoning in the classroom in preparation for the clinic requires more complex cognitive processes than simple memorization. Observation of both typical and atypical children and the posing of problems to be solved assists students in the experience of this process. Peloquin and Babola (1996) and Babola and Peloquin (1999) proposed the creation of a "clinical climate in the classroom". However, their original work did not explore the use of technology within the classroom for this purpose. The project described in this paper combines the use of multimedia to make the observation of typical and atypical children more accessible to students who do not have access to clinical experiences while receiving classroom instruction.

The Project

The project combines multimedia technology and problem based learning instructional techniques to create a "clinical climate in the classroom" both within the classroom and using the web-based course format, Course Info. The goal of web enhancement of the course is to provide students additional opportunities to interact with the course materials and the instructor outside of class. In addition, students have the additional opportunities to further expand and apply skill and knowledge for evaluation, intervention planning, formulating treatment goals and objectives, and documentation of services of children with disabilities.

The project integrates videotaped vignettes and Power Point presentation into classroom instruction. Power Point combined with video is posted on Course Info providing on line web enhanced simulations. One to five minute video vignettes showing typical and atypical children in a variety of settings engaging in treatments and activities is used to create a clinical climate. Using digital editing systems, the videos can be edited for use in different learning environments. Video is used in three ways: edited stand alone video with and without narration, inserted into Power Point presentations for lecture use, and posted on the web. In addition, the vignettes are used in lab simulations for "thinking on your feet" exercises (e.g. for evaluations, goal writing, intervention planning, and documentation), and as a stand alone hands-on resource available for students to check out at the university library.

Conclusion

The incorporation on multimedia in to the classroom shows great promise to enhance the learning and development of clinical skills. The effectiveness of these techniques and materials will continue to be monitored and expanded.

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Using Web-Based Course Tools to Facilitate Committee Work

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Abstract: Most well designed web-based course delivery tools have common features such as electronic mail, calendar, chat rooms, and bulletin boards, to name a few. In this paper, the authors describe how these and other tools can be used to facilitate communication among members of committees and among faculty members in departments and colleges. The advantages of using such tools include saving face-to-face meeting time and reduced use of paper products. Some of the disadvantages include the fact that technology does fail, and time is initially needed to train people to use the web-based communication tools.

Introduction

Web-based course development, management, and delivery tools are generally used to deliver course related content to students enrolled in distance education courses. The various features that are often an integral part of such tools allow students, who are often geographically dispersed, to learn course content, and to interact synchronously as well as asynchronously with their classmates and the course instructor.

Common Features of Many Web-Based Course Tools

The increasing popularity of web-based education has resulted in the availability of many software tools that enable educators to develop, manage, and deliver courses over the web. While there are many course tools available, most of them have some common features.

For example, most well designed course tools offer built-in chat rooms that make it possible for students and instructors to communicate with each other in real time, but from geographically different locations.

Another feature that is common to all course tools is a bulletin board. By posting messages on the bulletin board and responding to messages posted by one another, a group of students and the instructor can discuss information related to a course. For example, a student can post a message early in the morning, and other students can post their reactions at various other times during the same day, the next day, or even later.

Calendars are also a common feature in many course tools. Calendars can be used to post deadlines regarding course related events, such as assignment due dates, dates of quizzes and exams, holidays, and presentation deadlines, to name a few.

Electronic mail is yet another feature that is common to course tools. Students and course instructors can use e-mail to communicate with their classmates and with the course instructor asynchronously. While everyone who has access to a course can read bulletins that are posted, e-mail messages can be more private in nature. This means that if a message is sent to a specific person or a specific group of persons, only those persons will be able to read the messages.

Using Course Tools to Facilitate Committee Work

Web-based course tools can also be used for purposes other than course delivery. Many of the same tools that enable an instructor to teach online can be also used to establish web-based communication forums that facilitate communication among faculty in departments and colleges as well as to facilitate the work of members of committees.

Online calendars can be used to post meeting dates for an entire academic year. Deadlines for completion of tasks can also be indicated by calendar entries. Agenda items can be posted as files for members to view before the meeting. Committee members can start discussing agenda items and issues by posting and responding to bulletins days before the actual meeting. This could save precious face-to-face meeting time, which can be used to discuss the more important and contentious issues. Committee members can also use the e-mail feature to discuss issues and ideas with other committee members on an individual basis, instead of posting bulletins for public distribution and reaction. Those who are away from campus, and are unable to physically attend, can use the chat feature to interact virtually with others during the meeting.

The same tools can also be used to facilitate communication among faculty members in departments and colleges. In fact any group of people that needs a secure and flexible means of communication can use web-based communication forums.

Advantages

Minutes of meetings, resolutions passed, policies, plans, annual reports, and other documents generated as a result of the work of the committee, can be posted online. Future chairs and members of a committee can visit the site, and learn what their predecessors have accomplished. This ensures the possibility of continuity in committee work. Almost all web-based course tools provide the ability to restrict access to those who have usernames and passwords. This ensures that committee members have the privacy to discuss issues and ideas, just as they would in closed-door meeting situations. In states that dictate an open door policy for meetings, provisions can be made to provide guests with access to the web site. If a significant proportion of committee work is conducted online, then the result is a corresponding decline in the use of paper. While one web-based communication forum will not make a significant dent in paper use, the use of large numbers of such forums could have a significant and long-term environmental impact.

Disadvantages

Not everyone prefers to communicate online for all purposes. Many faculty members may still prefer traditional means of communication, and prefer to receive paper copies of minutes, agendas, and other important documents that have implications for their professional development and the advancement of their careers.

There could be resistance from some people to the use of web-based forums to facilitate committee work. The body language, and the immediate verbal and non-verbal reactions to ideas and statements that are an integral part of face-to-face meetings, cannot be easily replicated even in the most technologically sophisticated web-based forums.

Technology can, and often does, fail. If servers go down, the communications forum will be inaccessible, thus disrupting the flow of communication. It also takes considerable time and effort to train people to use web-based forums. In the long run, however, this may not be a disadvantage. The time spent initially will result in saving time later.

Conclusion

Web-based course tools can serve as forums to facilitate communication in various settings, including among members of committees. A few forums are already in initial stages of use at the university where the authors of this paper work. The authors plan to continue to report the ways in which these forums are used. The authors sincerely believe that web-based forums have the potential to facilitate communication among faculty members in colleges and universities, as well as among members of committees.

Strategies for Coping with the "Deluge of Electronic Information" or "e-Deluge"

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Abstract: The author notes that the amount of electronic information that we receive is increasing every day, resulting in what he and possibly others refer to as the "Deluge of Electronic Information" or "e-Deluge." Noting that complete avoidance of information is really not a viable option, he suggests some strategies for coping with the e-Deluge. His strategies include examining the address of the sender and the subject heading, obtaining multiple e-mail accounts to divide and conquer information, using the "most valuable feature," and the "six seconds" rule.

Introduction

The growing popularity of the Web is increasing the amount of electronic information that people are receiving every day. Information, much like rainfall, first begins to slowly drop into our electronic mail boxes, with a few electronic mail messages here and there, from friends, relatives, colleagues and bosses at work, and from associations, institutions, and organizations or corporations with which we are affiliated.

The "Deluge of Electronic Information" or "e-Deluge"

When we subscribe to discussion lists, and to services that send information that are of interest to us, the pace at which electronic information flows into our mailboxes begins to pick up, and becomes a steady drizzle. We begin to get more and more information than we can cope with. The drops of information soon form puddles, filling the inboxes in our e-mail accounts. Right before our very own eyes, these drops of information quickly turn, first into a steady downpour, and soon thereafter into a thundershower, and eventually become what the author and perhaps others refer to as a "Deluge of Electronic Information" or "e-Deluge." Information pours on us from all directions, faster than we can assimilate and act on such information. Not only is information pouring on us from all directions, it is also flooding our cyber territories, i.e., our electronic mailboxes. Much like trying to find the proverbial needle in a haystack, we are soon forced to spend, and even waste increasing amounts of our time, trying to find those "drops" of useful information from the deluge of information with which we are confronted. There is definitely a need to develop strategies to manage the e-deluge that has become a fact of life in the information age.

Complete Avoidance of Electronic Information is Not an Option

Life in the information age is characterized by constant interaction with electronic information, good and bad, as well as useful and otherwise. More and more of our everyday personal and professional interactions take place electronically. Many e-mail and Internet service providers do offer subscribers the capability of blocking e-mail messages. Blocking messages from certain sources does reduce the amount of unsolicited e-mail that we receive. That still leaves us with a deluge of solicited or legitimate messages that we receive everyday. Complete avoidance of all forms of electronic communication is not a viable option, since by refusing to receive all e-mail, we also run the risk of missing important messages from employers, family and friends, and other useful communication.

Identity of the Sender and the Subject Heading

The first part of an e-mail message usually contains information such as the e-mail address of the sender. If the "from" address is not recognizable, then it is quite possible that the message is either from someone who has not communicated with us before, or it is one of the "junk mail" genre. The subject heading will help determine the category to which the message belongs. If the subject heading indicates that the message is not going to be useful, the chances are that the message will probably will not be useful. A word caution is in order here. The subject heading does not always reveal the nature of the contents of an electronic mail message. A quick look at the actual message may be necessary before a final decision can be made regarding the usefulness of the message.

Attachments and Links to Web Sites

E-mail messages often come with attachments or with links to web sites. Whenever possible, we should encourage those who send us messages, to include the content of the attachment in the message itself. That way we can read the information as we read our e-mail messages, without having to spend additional time to open the attachment or to follow the hyperlinks.

Subscribing Selectively

Selectively subscribing to discussion lists and other e-mail services ensures that we do not waste time wading through enormous numbers of e-mail messages. If a discussion list does not meet our needs, we should not hesitate to unsubscribe from the list. If messages sent to discussion lists are archived on the web, we can visit the site and read through the list archives before deciding if it is worth subscribing to the list. If the list in which we are interested routinely archives all messages, then we might as well visit the archives periodically and skim through the messages, thus keeping our mailboxes uncluttered.

Dividing and Conquering Information

Anyone who has access to the web can get free e-mail accounts. With so many web companies and services eager to provide people with free e-mail accounts, it might be a good idea for us to get a few e-mail accounts, the actual number of such accounts being determined on our individual needs. At a minimum, an account for messages from family and friends, another for communication with professional colleagues, and a third for work related e-mail might be necessary for the average person. Periodically logging into the different accounts and reading and deleting messages will make it possible for us to easily manage our electronic communications.

The Most Valuable Feature

When we are confronted with vast amounts of information in the form of e-mail messages and relatively limited time, we can make two choices: (a) save the message and decide at a later date if the information is usable or (b) decide that the information is not likely to be useful, and delete the message immediately. Deleting the electronic mail messages, whose contents are not likely to be useful, is probably the best course of action to take when we subscribe to many discussion lists. Those who subscribe to discussion lists will soon discover that of all the features in their e-mail software package, the "delete feature" is the "most valuable feature" of them all.

The "Six Seconds" Rule

Spending the least amount of time that is possible with every e-mail message that we receive can save us a lot of time. Responding to important e-mail messages will take much longer than six seconds. However, it should not take more than six seconds, and preferably much less, to decide whether to delete a message, respond to it immediately, or save it for later use. If it takes more than six seconds to make a decision, we should save the message and read it again at a later time.

Conclusion

In this brief paper, the author has attempted to provide some strategies for coping with what he and possibly others refer to as the "e-Deluge." He is developing additional strategies, and will be happy to share these with others who are interested in trying these strategies to cope with the e-Deluge.

Making the Most of Support Resources : a Methodology to Handle the Rapid Growth of On-Line Courses

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Abstract: Faced with the rapid growth of online courses, the Centre of Educational Technology of the Free University of Brussels has put in place a methodology to speed up course development. Basically, academic staff are offered the choice between two "paths" : a "do-it-yourself" path and a "do-it with us" path. The first approach relies on the use of templates allowing the rapid creation of the course framework, and on a specially designed, modular on-line help combining technical and pedagogical advice. The second approach uses Excel-based forms to provide staff members unfamiliar with the Web with a simple and standardized way to enter their data.

Introduction

Web-based course management systems like WebCT, CourseInfo or TopClass are now mature products, and their popularity in the educational market is growing rapidly. With the availability of these user-friendly tools, on-line courses are flourishing everywhere. According to the Telecampus database, the number of *fully on-line* courses was above 17,000 in November 1999 [4] - and this figure does not take into account the courses that just *make use* of some on-line components. In any single institution, once a virtual campus is launched, the catalogue of on-line courses can explode in just a few months. To take a single illustrative example, since the installation of WebCT in September 1997, the number of on-line courses at the University of Georgia (UGA) has reached one thousand, and the number of students enrolled has reached 32,000, in less than two years [2] [3] !

This growth, however, raises an important issue : whereas the number of teachers going on-line increases exponentially, the size of the support teams remains more or less stationary. The "user-friendliness" of the tools is very appealing, but beware, setting up an on-line course is demanding. As the target population grows from the technically trained, "early adopters" to "mainstream" teachers, more and more individuals will lack the specific training needed to produce well-designed HTML documents and, having other priorities, will not be willing to spend time learning these skills. Not to mention that, even if they receive formal training, all teachers will still need technical support - how will the small teams in charge of helping users handle hundreds of requests ?

The Virtual Campus of the Free University of Brussels

Since 1998, the Centre of Educational Technology of the University of Brussels [1] has developed a "Virtual University" site [5] [6], in order to provide staff with both the tools and the support needed to "go on-line". To cope with the above-mentioned problems, a methodology has been put in place to help teachers to develop their courses.

Basically, after a first meeting to define or refine the project, the staff are offered the choice between two options : a "do-it-yourself" option and a "do-it with us" option. The "do-it-yourself" approach relies on the use of templates allowing the rapid creation of the course framework, and on a specially designed, modular on-line help service explaining the most important operations step-by-step, combining technical and pedagogical/methodological advice. The "do-it with us" approach uses Excel-based forms to give staff members who are unfamiliar with the web with a simple and standardized way to enter their data; the files are then processed semi-automatically by the support team. Of course, staff members are free to mix the two above-mentioned methods, or to switch between them. As HTML editors become as common as word processors, we expect more and more teachers to migrate gradually from the "Do-It-With-Us" to the "Do-It-Yourself" option.

The "Do-It-Yourself" path

Some teachers (a minority, in our context) are familiar enough with the technology to become very quickly independent in the development of their course. For those interested, a 2-days **workshop**, based on materials provided by the teachers themselves, is provided to familiarize them with the WebCT environment. Most teachers in this category , however, will prefer "to learn by doing" and proceed immediately with "real" development. As soon as a standard form has been completed, in a few minutes an empty course is created and put at their disposal. This course is based on a **course template** which includes all the support functions of WebCT; the functions not required by the teacher are then deleted, which is a speedier operation than the opposite. The template includes a specially designed **on-line help** system that is modular (it concentrates on the tools actually used in the course) and task-oriented (it explains the most common procedures step-by-step, as opposed to WebCT build-in help system that is feature-oriented). Beside the technical information, the help includes methodological and pedagogical advice on how to integrate each tool into the course and how to use it the most effectively. Hence, the teacher is able to learn "just-in-time" what he needs to know to fill the course shell, and can contact the technical support when a problem is encountered.

The "Do-It-With-Us" path

For the teachers who are unfamiliar with the technology, or reluctant to learn a totally new environment, there is another option. Excel templates have been developed, that allow teachers merely to complete cells with the necessary information (the various parameters of quizz questions, for example). Every file is self-explanatory, through the use of embedded comments. We then use the Mail Merge function of MS Word to capture the data and produce a file that complies to WebCT syntax. The resulting text file is then imported in WebCT to produce the pages the students will eventually see.

Conclusion

The "Do-It-Yourself" option is suitable for teachers who wish to keep their independence. On the other hand, the "Do-It-With-Us" option means the intervention of the support team in the process, and at the same time an opportunity for teachers to reappraise their courses in a pedagogical way for the Web.

The method also enables the automatic recovery of material (quizzes,…) developed with other software.

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Looking for Alternative Ways to Query Database through the Web: An Iconic Approach with IVQS

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Abstract: In this paper an alternative iconic approach to database querying through the web is discussed. IVQS, an iconic visual query system, is presented. The system has been developed as a Java applet in the ENEA Casaccia Research Center in collaboration with the University of Rome "La Sapienza". The system allows the web end user to access different multimedia relational databases through the web with an iconic interface (each query has an icon representation). An overview of how the system works and of the system architecture is given. Then the experimental results, using IVQS in Long Distance Learning and Scientific fields (Energy), and the final comments are discussed.

Introduction

Accessing databases through the Web is currently an active area of research (Nguyen et al., 1996). The main problem is to provide a friendly interface for end users to query remote database (Thimbleby, 1991, Mullet et al., 1995). Most systems provide three kind of querying: text search engines, form-based interfaces and natural interfaces. An alternative way is iconic querying. Starting from previous works (Fontana, 1995), a Visual Query System (VQS), called IVQS (Iconic Visual Query System), has been developed. This system allows the user to query remote and different multimedia RDBMS through the Web using an iconic interface. The system offers two kind of iconic querying: *query icon*, where an icon represents a query, and *entity icon*, where an icon represents an entity (a table in a relational DB). An iconic representation of a query can make easier for the end-user or the inexpert user to query a remote database without knowing the internal structure of the database or compiling exhausting forms. Our system has been used in education fields obtaining good results. IVQS has been developed as an applet Java so it's completely platform independent and it doesn't need any installation on client side.

System Overview

The IVQS prototype is a Visual Query System developed at ENEA Usability Lab to access and query remote databases through the Web. The system allows to create and execute queries to remote databases and to have a results visualization. The system is a Java Applet, executable directly through a Java-enabled Web Browser (without needing any installation). The system provides two kind of iconic querying :

- *Query icon*. Each icon represents a query. More icons can be grouped inside a folder so that the icons are structured in a tree. The user can execute the query double clicking on the icon.
- *Entity icon*. Each icon represents an entity (a table in a relational DB). Between two entities a query can be associated. Dragging an icon entity and dropping it on to another one, the associated query, if exists, is executed. For example, if there are the entities (tables) DEPARTMENT and EMPLOYEE, it can be associated a query that is the join on the common field DEPARTMENT_ID.

An icon editor is provided to associate an icon to a query or to an entity. In this way the user can create his own icon or import an existing image specifying an URL. The system provides a multi-user environment with userid / password authentication. Each user has a list of his favorite queries. Two kind of user are handled:

- Expert User (*Super User*). This kind of user can manage the system to create and modify queries, entities and can set up the result display layouts. The user has a good knowledge of relational databases and of their structure. The user can create queries visually selecting databases, tables, attributes and conditions. The system can execute queries to the most known relational databases such as Oracle 7.x, 8.x, MS SQL Server, MS Access, Informix, Sybase and ODBC-compliant data sources. In particular, choosing two or more different database, the user is able to build a query involving tables from different remote RDBMS. The user can use the system by himself or as an administrator for a set of end users.

- End User (*User*). This kind of user uses a structure already set up by a super user. The user deals with predefined queries and entities. Typically he's neither a computer nor a database expert; the user can use the system without knowing the internal structure of the databases. The user can have his own set of favorite queries.

Every data related to the user is stored in the system database.

IVQS provides two kind of result display: table and form. In the form result display it's possible to customize the visualization layout in terms of object position, font type, size, style and color. Objects can be text labels, images, Web resource links as URLs. In the latter case the user can open the resource that will be handled by the browser. Multimedia objects, such as movies or sounds, are placed in a specific area (media area).

Two typical uses of IVQS are:

- IVQS as a visual database interface for the end user, who can access a set of remote databases in a quick and easy way using predefined queries pre-built by the administrator.
- IVQS as a tool for long distance learning, both for the administrator who can manage the students database and for the students as an interface to access structured information collected by multimedia cards. In particular using IVQS applications in natural science and materials have been implemented.

IVQS as an applet is stored in the Server. When the client Web browser sends the request, the Web Server sends back the applet, which starts being executed on the client. The applet, because of its security limitations (Tanenbaum, 1996) can open socket connections only to the originating Server. On server side we used Symantec DBAnywhere Server, which can access various kinds of remote RDBMS. In this way the applet communicates with DBAnywhere Server to send query and to get back results.

Experimental results, conclusions and future work

IVQS has been used on a set of existent databases, each one very different from the other in terms both of information and target users. Here is the list of the databases where IVQS has been applied:

1. Users Database of FAD (Long distance learning), ENEA web site for long distance learning on the Internet.
2. G7 Global Inventory Project (GIP). An Internet inventory of G7 IT projects. The target users are Internet ones.
3. Prosoma (PLUS), EU Web site, a multimedia database containing the most relevant project results in Europe. In this context, IVQS has been integrated with IVAS (an interface to a Simulation Algorithm of an electric mechanism) to improve the usability degree of the system.
4. Animals database for primary school children within the Italian Internet-School Project.
5. Cometa database. A material database designed for field experts.

In all these experiences, IVQS has been tested by the users to measure its usability (ISO, 1997). The results obtained, in terms of user satisfaction and user efficiency, according to *MUSiC* performance measurement method (Macleod et al., 1997), showed that a query iconic representation allows a better perception in user's mind making it easier to memorize.

The increasing number of Web users is looking for convenient ways to search information on the Net and to collect and query data from different sources through the Web. It's necessary to develop new alternative tools for such tasks. It has been introduced IVQS, a Visual Query System to query remote database through the Web using an iconic interface. That is alternative to the form-based web pages which are the most common interface nowadays. The system has proved that an iconic interface is really easier to use for large end-user groups. As future features it's planned to provide a completely modular architecture (to add functions easily), to migrate to Java 2 (to speed up the downloading) and to have animated icons (to add more information content to the query).

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Upgrading Face to Face Higher Education Learning

Using a Web Based Environment

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Abstract: The recent cultural, social and economic change and the integration of Information and Communication Technologies in all aspects of modern life have immediate consequences for Higher Education. Introducing Distributed Learning in Higher Education in a strategically planned form can help Universities face some of the inevitable challenges.
This work presents a web-based environment that successfully introduces ICT in Higher Education as a strategy of integration of face-to-face and distributed learning. The proposed model extends all the educational aspects (classroom, administration, hall, library, etc.) into a "virtual" environment that extrapolates the actor behavior into the web. Results of the implementation of the model to full-time young students and mature, employed students are presented, compared and discussed.

Introduction

The recent cultural, social and economic change and the integration of Information and Communication Technologies in all aspects of modern life have immediate consequences for Higher Education. Introducing Distributed Learning in Higher Education in a strategically planned form can help Universities face some of the inevitable challenges (UNESCO 98). In this new world the teacher will be a guide when using the Web as the global hypermedia archive with its informational structure where students can navigate (and …get lost). Teachers become even more important when the Web is used to mediate communication in Distributed Learning Environments. Their role here will be the creation and promotion of thematic neighborhoods, Learning Communities with a collective intelligence capable of enhancing knowledge construction by the integration of students, teachers and experts in discussions and activities (Rheingold 93). To achieve interaction in the community teachers must know how to overcome the loss of hints (speech, visual, etc…) that help establishing these groups in f2f situations.

Web Based Distributed Learning Environment

The proposed model departs from the existing f2f Higher Education model. Learning Communities are created in the usual form but the model introduces new virtual features that allow extending these Communities into a no wall environment by incorporating a web-based environment that extends the classroom, other support areas (library, course and student management) and free activity areas (Carvalho 99). This way, the communities can expand to the student's houses or workplaces. This of course creates synergies with other participants like work colleagues, families, experts, etc. The main component is the classroom. The traditional f2f learning process is expanded using "virtual" mechanisms to access information, discuss concepts and implement practical exercises.

The f2f model develops on a cycle with theoretical classes, practical classes and labs. Additionally students can contact teachers in some pre-determined periods called pedagogical assistance hours. This model presents several problems like:

- Low comprehension of concepts in the theoretical classes due to low presence rates, incapacity from students to understand immediately the concepts, incapacity of the teacher to transmit the concepts, etc.
- No benefits from the practical classes and labs because students don't master the concepts.
- Reduced teacher-student contact due to large students groups or even shyness.

The new model tries to solve this problem by:

- Allowing that information acquisition to be made individually, at the student rhythm, by providing study guides, hypermedia interactive documentation, tutorials and additional references, simulations, exercises and examples for self-practice, self-assessment tools
- Using a discussion forum to provide additional discussion of concepts and to promote group activities.
- Increasing the number of direct communication channels between teacher and students.

The proposed environment includes areas that support the classroom. The additional areas include libraries, management support (student and course) and a free zone, where students and teacher can interact freely.

The web base environment was implemented and tested on a specific discipline (Programming Languages) of a course in Computer Science. The target group was the first year undergraduate students that followed that discipline (about 350). The fact that the discipline was lectured simultaneously to full-time and part-time students also allowed comparing results and assessing each group's motivation and interest in the environment. The evaluation was centered essentially in the quantification and qualification of the students' reaction to the environment and their effective use of the expansion possibilities.

Results and Conclusions

Although students were free to use or not the environment, results show that they were very much interested in it: 53% of the young, full-time students used it frequently or very frequently and 37% accessed it regularly. 72 % of the mature, employed students used it frequently or very frequently.

Students accessed the environment from several places: school, home and work. Clearly the most significant place was the school itself. Students complained a few times of technical problems on accessing from the exterior (slow response time, server system down), which can explain this. Nevertheless accessing from home is also significant specially if considered that only 60% of students had access from home (100% from the school).

Use of documentation (all aspects) and self-assessment facilities was predominant. The students also used the direct electronic communication channels that strongly reinforced the link with the teachers. Nevertheless the discussion forum was not used as expected which can be explained by the students' lack of habit in its use. Students were very satisfied with the methodology, environment and tools provided. Clearly, contacting electronically the teacher was the most rewarding aspect for the students. Also as side remarks students showed interest in continuing using this methodology in other disciplines.

The results allow us to conclude that students are strongly motivated to use this methodology in their learning process. Nevertheless the results must be taken with some care because the target group involved were Computer Science students, which are very technically motivated and experienced.

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In-Service Training of Trainers in a Web - Based Environment

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Introduction

The Pedagogical Institute of Athens with the support of the Leonardo Da Vinci Program of the European Union has developed an experimental common curriculum (ECCA) in agriculture for use in agriculture training secondary schools. In a further stage, in partnership with Scottish Council for Education Technology, National University of Ireland, Maynooth and TECHNO-Z-F&E GmbH, has developed a methodology for delivering parts of the ECCA in an innovative and integrated way for in- service training of trainers.

Although there is not substitute for the immediacy and effectiveness of face to face teaching and learning , on-line teaching and learning has become very popular in recent years. It involves new interactive technologies, particularly the Internet, to facilitate asynchronous learning environments. The Pioneer, developed by one of the partners, was used as a communication and learning environment.

Given the different nature of agriculture training and development in the four countries of the project, the ECCA and the methodology could be applicable to other countries as well.

Project Approach

The outcomes of the further stage were training programs, modules and evaluation tests for open and distance in service training of trainers.

The project had the following phases:

I. Goals and definition of the open and distance training methodology

II. Development of the selected methodology

III. Awareness and familiarization with Pioneer

IV. Experimental Development of content

V. Pilot application with in- service training of twenty trainers,

VI. Evaluation of the project.

Two aspects had to be handled during the project: the trainers' training on the subject and the training in the applied on-line methodology. The communication between the trainers was basically electronical. There were organized a number of workshops for familiarization with the scopes of the project, exchange of views and job allocation.

Methodology focuses on the following points :

- How to handle an Internet connection
- How to get to the project web –site
- How to communicate by e-mails, chats etc.
- How to design didactic material.

- How to use the features of the Pioneer environment
- How to identify the suitable materials for on-line delivery
- How to place the chosen course's schedule on-line.
- How to get feedback and answers.
- In general, how to use the technology from a technical point of view as well as from a pedagogical one

The developed methodology incorporated the following principles :

1. It is based on Training the Trainers model
2. It uses technology and demands a novice level for the participants. This level is becoming higher at the end of the project.
3. The learning and teaching models are flexible.
4. Didactic materials may be delivered in multiple ways.

Discussion

The need for continuous training and the increasing use of technology in education and training have created the necessity for developing new innovative and flexible methods for training of trainers. The aim of such methods is the developing a quality on-line environment. The project seeks to test in twenty trainers the possibility of enhancing the traditional delivery of teachers training courses by using web-based technology and familiarization with networked training products that can be used in different ways.

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Learner-Content Interaction in Web-Based-Instruction

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Abstract: Because content is the backbone of the web based course (WBC), and because interactivity between students and the course content greatly increases the potential for both the enjoyment of learning and the enhancement of cognitive skills, it is necessary to design and develop courses that engage the student in an interactive manner. Up to now interactivity certainly may have been the missing link for WBC's. However, over the last two years software and hardware have become available which may be used to greatly increase the level of interactivity in WBC's. Several different interactive strategies will be discussed in this paper. Though the strategies are skewed to the mathematics/ science disciplines, some of the ideas could be utilized in other subjects.

Introduction

In trying to develop WBC's, we should look at the successful interactive methods, strategies, and techniques that have been utilized in the traditional classroom. Because our students use a computer to take the WBC, we will find that many of the traditional interactive strategies can be easily enhanced beyond what can be done in the traditional classroom. Our purpose is not to simply copy the interactive methods used in the traditional classroom, but we must extend, expand and improve them. The text, graphics, interactivities, animations, practice test, humor, and a mastery test are the interactive ingredients of a WBC. Interactive approaches to several of these elements are outlined below.

Instructional Text

The instructional text in a WBC is to be compared to the lecture. In the traditional classroom the student hears the lecture, but in the WBC the student reads the lecture materials. The WBC text must amplify, clarify, and extend the significant ideas and concepts of the course. The text must be well organized and clear. It is better to have too much detail rather than too little. The informed student or the faster student can scroll very rapidly through the familiar material while the slower learner can take the extra time needed to digest the information. Effective instructional text will have several different interactive sections embedded in it. Different types of interactivities, which can be intermingled within the instructional text, will now be considered.

A Picture

Clearly labeled explanatory graphics should be found in the midst of the instructional text. These graphics can be created using any of the popular computer-algebra systems (Mathematica), converted to the proper file extension and easily up-loaded to the WBC. These graphics can be very helpful in clarifying concepts. Clear, concise organized text mixed with visual aids such as labeled graphics, makes a good combination for teaching concepts in mathematics and science.

Activity

In the traditional classroom, the instructor might ask the students to perform a calculation, plot a graph, or solve a system of equations, or carry out any type of operation during the class. We need this same capability in a WBC. In fact, not only can we do this, but we can do it more effectively than can be done in the traditional class. Because of time constraints in the traditional class this activity must usually be very limited. In a WBC, the students are working with computers and can do lengthy calculations very rapidly. The time constraint is not a problem with the WBC. With the Mathematica kernel loaded into the server it is possible now to use this computational engine to perform many interactive activities on the Internet in a WBC. The following URL, http://193.112.202.201/MathKernel/MSP/Plot3Dlive, illustrates an example of a three dimensional surface plotter. The graphic produced by this interactive three-dimensional plot routine can be repositioned using the mouse pointer so that it can be examined from any perspective. Student-content interactivities like this one are extremely effective (Schaffer & Hannafin 1993). While some of these activities will be assigned in the text, many students will use these capabilities to experiment on their own initiative. This type of activity would be very difficult to do in a traditional classroom because of the time constraint unless each student had a computer at his or her seat. Using JavaLink, a new software package produced by Wolfram Research, Inc., it is now possible to produce Mathematica functions in a Java program which can be easily incorporated into a WBC.

Animations

Animations are often difficult in the traditional classroom because of time constraints. However, animations in a WBC are simple to set up and they are powerful teaching tools that can be utilized to drive home the essence of a concept. Animations use the computer as a tool to help the mind's eye attempt to visualize a concept.

Practice Exercises

These practice exercises or quizzes, which don't count on the student's grade, should be placed periodically in the instructional text to allow the students to determine if they really understand a concept. They give the student instant feedback and should give additional instruction for the missed questions. These practice exercises can be done as many times as necessary. These practice exercises also provide a method to extend the student's understanding to more advanced ideas without lowering their grade. From the outcome of a practice exercise, a student can determine quickly if they are prepared to go on to new material in the WBC or if they should review over the material they have already covered. Doing well on a practice quiz will give the student confidence about the mastery test which will count on his or her grade.

Conclusion

In addition to the above interactive elements, there would be mastery tests which would give instant feedback about the student's performance, there could be links to other relevant sites on the Internet, and finally, there should be some elements of humor, which will usually lower the drudgery of the learning curve and establish a positive relationship between the learner and the teacher. The indication is that the ability to overcome time and location with WBC's will revolutionize education. However, content interactivity will be a necessary ingredient of WBC's if they are to be quality-teaching systems.

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Can Consideration of Learning Styles Improve Web-Based Learning?

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Abstract: Web-based experiments were performed to test the validity of learning styles. The preliminary data indicates that self-reporting of learning styles does correlate with learning in web-based environments designed to favor a particular learning style. However, the learning style instrument tests did not yield results that correlate positively with student learning or with the student's self-reported learning style. These results suggest that student learning can be improved in web-based environments by matching the presentation style to the student's learning style. In courses where materials are presented in multiple styles, students can self-report their learning style and then automatically be given a suggested path through the course materials that best suits their learning style.

Introduction

The increased use of web-based learning materials in traditional and on-line classes has generated a renewed interest in the issue of learning styles. As faculty consider the pedagogical consequences of web-based materials, they must examine the benefits of having educational materials presented in multiple ways (audio files, video clips, written text, pictures, diagrams, simulations, etc.) and ask whether certain formats will be better suited for certain students. In other words, do different students have different learning styles?

An examination of the literature on learning styles indicates a lack of general agreement on the definition of learning styles or learning preferences. For example, different researchers define different dimensions to the concept of learning styles: active versus reflective; sensing versus intuiting; visual versus verbal; sequential versus global; visual versus auditory versus tactile versus kinesthetic, etc (O'Connor 1997) (Felder 1996). A variety of instruments exist that are designed to measure a student's learning style along a given set of dimensions (Ross 1997).

While many papers have been written about learning styles (Carver et al. 1996) (Stahl 1999), most of the published reports are based on qualitative results: anecdotal evidence and case studies. Additional quantitative experimental research is needed to test the validity of learning styles in web-based education. Only if both the learning styles concept and the instruments for measuring learning styles are found to be valid, can they be used to improve web-based educational software. Web-based applications could administer a learning styles instrument to each user and thus gain an indication of the student's learning style. The software could then use this information to suggest to the student a particular path through the learning materials that incorporates the materials whose presentation form is most appropriate for the student's learning style.

Experimental Design

The experiments are preliminary and thus test just a single dimension of learning styles. The dimension selected was chosen based on both its importance to learning in general, and its relevance to web-based learning: visual versus auditory. The dimension was limited to the distinction between reading a text and listening to an audio segment of a professional actress reading the passage. Only one learning styles instrument was tested. The instrument selected was the on-line version of the Learning Styles Inventory used at Miami University and available at http://mumnt1.mid.muohio.edu/phy/inventory/styles.htm. While the validity of the visual/auditory dimension is being tested, questions for the individual/group dimension were included in the experiment. Since the two dimensions could be assumed to be orthogonal and since only the visual/auditory dimension seems to be relevant for the learning task selected, the individual/group dimension serves as a control.

One of the difficulties in measuring learning performance is that if the student has been previously exposed to the material, then the measurement might not reflect the learning from the experimental situation alone. In these experiments GRE reading comprehension questions were utilized because they have been designed to solve the problems of prior knowledge and uniform difficulty. Four comprehension style passages with four multiple-choice questions were selected from (ETS 1994). The learning in the experiment consists of the student either reading the text or listening to a professional actress reading the passage. The percent of correct answers to the questions was used as a measure of the amount of learning.

The web-based experiment consisted of four basic sections: collection of demographic data, self-assessment of learning style, the learning style instrument, and the learning tasks. For the learning task, each passage was first presented, and then the passage was removed and the students answered the four questions about the passage. To control for time, the text passage was displayed on the screen for the same amount of time as required to play the audio passage once. Students were allowed an unlimited amount of time to answer the questions.

Experimental Results and Conclusions

Twelve student volunteers participated in the initial experiment. The results of the learning styles assessment instrument did not correlate strongly with self-reporting on learning preferences. A regression analysis was performed on the ratio of the self reporting of reading versus listening and the ratio of the results of the learning styles instrument scores for visual versus auditory. The R square value was only found to be 0.54, which suggests some correlation, but not a high level.

The performance of students in a simple web-based learning environment did not correlate with their learning style as identified by the learning style assessment instrument. The students were divided into two groups: those with a higher score on their visual than on their auditory preference (the Visual Group), and the rest (the Auditory Group). If there was correlation, then it would be expected that the students in the Visual Group would learn better when material was presented visually than auditorily. The results for the Visual Group are 55% correct for the auditory passages and 66% correct for the visual passages. However, for the Auditory Group the percent correct for the auditory passages was 44%, with 56% for the visual passages.

The performance of students in the simple web-based learning environment did correlate with their self-reported learning preference. Again the students were divided into a Reading Group and a Listening Group, but this time based on the self-reported learning preference. The students in the Reading Group learned more on the passages they read (65%) as compared to the passages they listened to (49%). The students in the Listening Group learned more from the passages they listened to (67%) than from the passages they read (63%).

The results do provide preliminary evidence that the learning style concept is valid for the listening versus reading dimension. In addition, there is evidence that self-reporting of this learning preference can be used to indicate the best manner in which materials should be presented for a group of students with a particular learning style. However, these results do not support the validity of the auditory versus visual dimension of the particular learning style instrument used. It would be desirable to perform similar experiments using other dimensions and other learning style instruments to test their validity using a larger test population. Such results will be of use to university faculty members who are developing web-based materials for on-line courses or to supplement traditional courses.

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A Surprise for Teacher: Web sites as coursework submissions[i].

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Abstract: This paper addresses a number of issues relating to the use of 'web technologies' by undergraduate planning students. It describes the resources, which are available within the Planning School, which have enabled the students to achieve high standards of communication and presentation without formal training. The issue of assessing of this work, alongside more traditional media forms, will be discussed. This is particularly pertinent in a discipline such as Planning where many of the academic staff are not familiar with 'novel' information technologies.

Session7678@WebNet2000

Context

A Planning degree is a professional and academic qualification. The field of study is multidisciplinary and a well-established description of planning graduates is that they are "generalists with a speciality"[iii] An important component of their general professional toolkit is the ability to communicate with the community, business, specialists and politicians.

Traditional verbal and written skills are formally taught, together with basic use of the common office based information technologies. The skills are reinforced by use, within a teaching form peculiar to Architecture, Fine Art and Planning Schools, "The Studio". These are a form of *practicum* where students work throughout a semester on a specific real-world issue, often liasing with community groups, NGAs and local political representatives.

The traditional outputs from a studio are maps, large format displays (equivalent to conference poster sessions) or some form of graphically illustrated report. This material is used to communicate issues to the other participants in the exercise and form an important part of the assessment process for student evaluation.

The Surprise! (See figure and websites[iv])

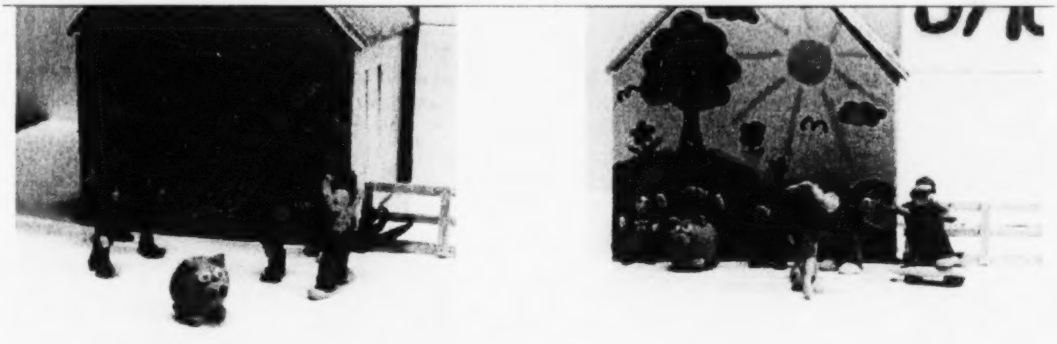

Figure: Two Frames from a "claymation" movie created by students, working with children on the urban problem of tagging, as part of a website

Recently a small number of students, in different years of the programme, have submitted some of their studio outputs in hypertext, hypermedia or multimedia form. The work being submitted on CD-ROMs which, in most instances, were multi-platform capable.

This innovation was surprising to the examiners and assessors, who were, initially, very impressed by the submissions.

Subsequent Analysis of the Surprise

These developments created a great deal of discussion amongst the staff and resulted in a number of questions and observations, which are summarised below.

What influenced the students in their choice of media?
An important issue in communication is choosing the appropriate media in which to transfer information. Subsequent discussions with the students, independent of the assessment process, identified their reasoning behind the choice of media. Again another surprise, the choice had not been for its novelty value in an attempt to achieve a higher grade but had been based on a more rational decision making process within the groups. For example, one of the groups working with primary school (grades 1-6) children had identified the children's enthusiasm for using the school computer facility; the students referred to the children as the "playstation generation". This preference over written form was then used in order to communicate a number of environmental issues, thus the choice of highly graphical HTML documents and multimedia products.

How did the students achieve these results?
Creating hypertext and hypermedia document has become easier in recent years, but this does not fully explain their ability to master the techniques without formal training.
Initial conclusions are: i) that the choice made a number of years ago to centralise the faculty provision of information technology resources and technical support has created benefits beyond the fiscal issue, ii) that cross-fertilisation of ideas and skills are occurring between the students in the different parts of the faculty.

What are the issues relating to assessment?
Initial analysis suggests that there is a tendency for the examiner to rate novel media forms higher than those traditional forms, particularly if they are not highly computer literate. If the quality of the content is as high as the traditional form then the work should certainly be assessed at an equivalent level. A higher grade should only be awarded if the choice of media achieves a higher level of effective communication. The novelty of this media in this context means that there are not many instances where its effectiveness can be evaluated. This is an area for future study, but needs to be addressed before in-equities in assessment occur.
A secondary issue, not unique to the media, is that of unconscious plagiarism and copyright infringement. Although not a new issue, the Web and today's software tools make copying – particularly images – extremely easy. This issue will be addressed within the format teaching programme.

Have the students gained from the experience
An interesting additional outcome of this work is that some students, who have previously not performed at a high level, through working with the media, have become more interested in all aspects of their studies. It is hypothesised that they displayed talents, in using the technologies, which previously were not recognised. This would have had the effect of increasing their own feeling of worth and status within their peer-group, leading to greater confidence and involvement.

Future implications & Conclusions

There are some immediate issues, such as copyright of electronic material, which will need to be addressed within the formal teaching framework. More research is required to inform the examiners and create assessment, marking guidelines. An area of much internal debate and lack of conclusion is the whether we, as academics, should introduce some formal teaching relating to the use of the technology or allow the informal processes of learning to continue to occur. A concern is that the student's creativity and enthusiasm could be lost if "**HTML**" was placed alongside the technical training of spreadsheets and statistical packages. The converse is that the informal learning processes can sometimes lead to the rapid spread of bad practice. It may be that, by the time we have an answer to this problem, a new media form will have arisen!

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[i] Acknowledgements are to be found at www.appfa.auckland.ac.nz/People/Craig

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Enhancement of Technical Courses with Web Audio

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Abstract: There has been considerable discussion by purveyors of distance education about using audio and video web streams to deliver course content. This paper addresses their integration into a traditional classroom setting. It describes how web audio solved two problems specific to a Software Development course, the effectiveness of student-produced content, and the tools used.

Students in our senior level Software Development course design, implement, and document a software solution for a local business. During the term, the student teams make periodic progress reports to the class showing user requirements, various design diagrams, code samples, and other types of technical documentation. Microsoft's PowerPoint has long been the presentation tool of choice but recently two problems have become apparent:

1. Project complexity had become too much to absorb within a class-hour show & tell.
2. Too much time was devoted to deriving PowerPoint slides from the actual documentation.

The first problem was solved with the release of PowerPoint 2000, which permitted narrated web shows to be recorded. These could be studied before class at a student's convenience and then the in-class hour used for amplification and discussion. Students had no trouble turning on its Record function, narrating their slideshow, and clicking "Save As Web" to create a show that streamed the audio in synch with the slides and available 24/7 on the school's web. If you have a fast Internet connection you can see an example at http://magi.sou.edu/asp/cap00 and select the first PowerPoint show. Audio annotation showed itself better than text for describing complicated drawing such as a Data Flow Diagram. The IS director of Timber Products (TP), a sponsor for several of these senior projects, was enthusiastic about the ability of these web shows to communicate to his staff and especially users in remote regional offices.

Creating a technique for producing presentations that used the actual documentation approached the second problem. While narrated PowerPoint web shows are engaging and communicative they quickly become out of date. Since software development entails constant modification, TP's IS director asked, "Can you make these shows annotate our actual documentation?" TP used Word, Excel, and Visio and he wanted presentations that would always display these documents in their current state. Microsoft's Internet Explorer 5.0 displays these types of documents in their native formats through OLE technology and allows them to be edited and saved on TP's intranet. A user could save the document (including its art) to her local drive (in contrast to saving an HTML page with its separate image files). Authorized IS personnel with drives mapped to TP's web directory could save modifications directly to the web. In other words, authorized personnel could easily maintain software documentation on the corporate web in their native formats. This editing feature of IE5 also serves educators, like myself, who wish to maintain course materials in native format, not HTML or PowerPoint, and publish them on a web.

But now PowerPoint showed some shortcomings. It creates GIF slides that go out of date and rearranging them required re-recording the audio. So a prototype was built which allowed narration to be synchronized with the actual documentation, not PowerPoint slides, and their sequence control by a simple text file. For an example, go to http://magi.sou.edu/asp/cap00 and select the first Prototype show. Visually compared to the PowerPoint web show it consolidated PowerPoint's controls functions into a single navigation bar, the table of contents into a dropdown list, and the AutoStart function has three modes rather than two:

A -- audio automatically plays upon page change
+A -- pages and audio play automatically (the presentation plays by itself)
-A -- user must start the audio manually

By "Viewing Source" on the Prototype the interested reader can view its JavaScript code. But we'll refrain from comparing features further except one: the prototype uses a simple text file to script the sequence of documents and sound files. An author can create a script of html pages, Word documents, or URLs combined with audio files with Notepad. To illustrate how a variety of source materials and audio can be sequenced here is a script for a show with five pages:

```
"Timber Products     img001.htm                img001.asf\n" +
"Requisitions        req1.doc                  req1.asf\n" +
"IS Challenges       img004.gif                img004.asf\n" +
"Regional Plan       http://tp.com/plan.doc    plan.asf\n" +
"Software Demo       video.htm                 cap003.asf"
```

Newlines (\n) terminate records and tabs delimit fields. A record has three fields: the title for the Table of Contents, the page/URL, and the audio file (if it exists). The script above shows a variety of source materials and accompanying audio-visual files (.asf is Microsoft's Active Streaming file format)

"Timber Products" is a regular web page
"Requisitions" is a Word document
"IS Challenges" is a GIF image
"Regional Plan" is a URL on another server
"Software Demo" is a screen cam video

The prototype is more flexible than PowerPoint since the author can edit the script with a text editor, replace the narration of a single slide, use and rearrange source documents, scanned images, videos, and other web sites. Many technical findings came from using this prototype, but we'd like to discuss the efficacy of web audio to enhance technical courses. The final for the Software Development course was designed to give us an informal appraisal.

The final required five 3-student groups to each produce a narrated web show on an aspect of their project and to submit five questions about its content. Their submissions were compiled into a 25-question exam that all were required to take but whose scores would not affect their grades. Their shows were posted on our web for a week before the exam. At the exam they answered all questions but were instructed to cross out the title of any show they didn't watch. The average student score was 23 out of 25. For comparison, five faculty members who had not seen the presentations averaged 15. This demonstrated to me that students had successfully authored presentations, concocted reasonable questions and most importantly, learned from each other through their own shows. Sharing of project experience has always been an objective of this course but in-class presentations had become an increasingly ineffective vehicle for this. These results raise my hopes that these web shows can deliver student content that enhances course content. I thought it remarkable that so many shows were watched given that they weren't required. Only two shows were not watched out of 75 (15 students times 5 shows). These students appeared willing to 'study' without grades being the motivator but the Hawthorne effect, multimedia's current popularity, competitiveness, and simple curiosity were also in action.

At the very least, this experiment enhanced the Software Development course by adding audio to the toolkit for documentation. More grandly, the web shows demonstrated a considerable potential as a viable educational media. The next test is to use teacher-generated web lectures to enhance a technical course with extra material. My target is to produce an orchestrated series of shows for our beginning Web Development course. Technologies are constantly changing (PERL, ASP, JSP, XML, Java Servlets, etc.) No book or class can survey them all but many could be available through a library of web show demos starring some of our local experts. Some shows might be required class assignments, some just available for enrichment, and some serve as resources for other classes.

Audio and video web streaming is rapidly being deployed as a means of delivering distance education. This work begins a study of its effectiveness in solving specific problems in the traditional classroom. This first study identified some requirements for a more flexible authoring tool. It showed that students could produce and learn from their own presentations. Future studies will expand the types of authors, the uses for web shows, and attempt to identify which features in shows, tools, and context of presentation are best.

POSTER / DEMONSTRATION ABSTRACTS

An Astronomical Observatory on the Net: a project of a telescope online.

Anna Auricchio, Astronomical Observatory of Capodimonte, Italy; Enrico Cascone, Astronomical Observatory of Capodimonte, Italy; Gennaro Cretella, Astronomical Observatory of Capodimonte, Italy; Gianfranco Spirito, Astronomical Observatory of Capodimonte, Italy

In order to extend to a wider public our Observatory out-reach facilities, we propose a project of an internet site, whose primary goal is education intended for students and for anyone interested in learning about our universe. The most important aspect of the project is the use a telescope, with digital camera, as a remote network device which will allow to users to acquire and analyze real astronomical images data. Electronics and the presence of an astronomic objects catalogue, permit the location and observation of the major planets as well as hundreds of deep-sky objects. Relevant astronomical and space events images - eclipses, comets, asteroids - will be available for acquisition across Internet. Anyone on the Internet can register and ask the telescope to look at anything in the northern night sky. Observations are automatically prioritized and scheduled and completed by the telescope as time allows. Also the software for image reduction will be available on the site. The official date the telescope became operational was September 2000. We are currently working with a number of schools and institutions in order to establish a preliminary collaborative partnership between Observatory Astronomers and the school system. This project would be unique in Italy, where from a few years there is in progress a strong evolution of the School system towards experimental programs. Broadly defined, the project will be the vehicle for enhancing excellence in science and technology education.

Developing Best Practices for Prospective Teachers and Mentors with Technology

Linda Bennett, University of Missouri-Columbia, USA

The "Mentoring Web Site" http://www.coe.missouri.edu/~esse/mentor began in January, 2000, for teacher certification students in the Teacher Development Center at the University of Missouri-Columbia who are enrolled in elementary social studies and a field experience. This project provides a means for delivering a technology support system for field experience. The project provides the technological and pedagogical resources for university instructors, classroom mentor teachers and university students to develop as professionals within a virtual learning community. The participants develop strategies to incorporate educational technology in the elementary classroom. University students and mentors use technology to communicate, collaborate on projects, research new bodies of knowledge, and design multimedia projects. As an ongoing project, the mentoring web site is being refined based on feedback from the students and classroom teachers.

ETRDL: a Digital Library for the European IT Community

Stefania Biagioni, IEI - CNR, Italy; Carlo Carlesi, IEI - CNR, Italy; Pasquale Pagano, IEI - CNR, Italy

The ERCIM Technical Reference Digital Library (ETRDL) has been designed to meet the needs of scientists and librarians of the European Research Consortium for Informatics and Mathematics and thus offers a set of services for three distinct user types: information providers, seekers and administrators. ETRDL has been implemented as part of an international federation: NCSTRL (the US Networked Computer Science Technical Reference Library) and adopts the well-known Dienst software. However, in order to meet the specific requirements of a European research community while maintaining compatibility with NCSTRL, Dienst has been adapted by extending the existing functionality (e.g. search and browse), adding new capabilities (multilingual interface and access functions) and implementing new services (on-line document submission and withdrawal, administration). The system is open, providing a core set of services for the entire ERCIM collection which can be further specialized on the collections of the single ERCIM institutions according to local requirements.

The Illusionist, an environment for building pedagogical agents

Eleonora Bilotta, University of Calabria, Arcavacata di Rende (CS) Italy

We should like to propose a conceptual framework in which the design and implementation of life-like pedagogical characters can be grounded, with the aim to overcome the difficulty to program. The system has been designed through a visual language interface, that permits to script the agent behaviours, by dragging and dropping icons in the timeline of the multimedia sequence. Since we think that a pedagogical life-like character is a scaffolding technology that teachers have to learn to design, we propose a methodology to build up a pedagogical agent. The methodology is the following: * study of the character's appearance, mood and behaviours; * analysis of conversational interfaces and creation of a dialog model between students and the pedagogical agent; * study of the agent's behaviours in the educational constructivist environment; * organisation of its functions in the learning domain.

The Connections Project

William Bolen, Nebraska ESU 10, US; John LeMay, Nebraska ESU 17, US; Stacy VanBorkum, Nebraska ESU 16, US

The Connections Project is a federally funded Technology Innovation Challenge Grand designed to provide a model to schools across the nation in improving student learning aided by technology, including the use of the web and video production. The schools involved in this project have a variety of characteristics that make education challenging, characteristics that are common to many other schools across the nation.

Web Based Instructional Delivery Systems: The Story of One Program's Exploration Process

Marty Bray, University of North Carolina at Charlotte, USA; Claudia Flowers, University of North Carolina at Charlotte, USA

This paper describes the planning process that a College of Education faculty used to meet the challenges of delivering coursework using a variety of distance education tools including two-way audio and video, the web, and chat sessions.

The planning process began with the faculty exploring the different distance education tools available to them. Next, the faculty looked at the courses that they would deliver to these students and sought to determine what course content was best suited to which instructional delivery method. Based on the rubric that was developed as a result of this planning process the faculty identified the resources that they would need to develop and deliver their online courses.

Redesigning the Traditional Classroom to a Technology Learning Facility

Barbara Brazon, Penn State University Wilkes-Barre Campus, USA; Mary Lynn Brannon, Penn State University Worthington Scranton Campus, USA

We encourage faculty to be innovative. We provide teams of instructional designers to aid faculty in the integration of technology, use of the Internet and active learning strategies into their courses. To be successful faculty must have appropriate support systems. The teaching environment is a critical support system. How can we ask faculty to integrate technology without providing them with the equipment, telecommunications and convenience of a "plug and play" environment? The integration of technology in to the classroom coupled with the infusion of the World Wide Web in to the craft of teaching necessitates the rethinking and redesign of traditional classrooms. As instructional designers our role is not only to aid faculty in the pedagogical issues of technology integration, but we must also provide consultation on the redesign of existing classrooms. This poster session will address the problems that arise in converting traditional classrooms to technology learning studios.

The Electronic Portfolio: An Assessment Tool for Online College Courses

Margaret Burk, Muskingum College, USA; Rosemary Carlson, Morehead State University, USA; Bridgett Davis, Morehead State University, USA

With the enormous growth in Web-based or online distance learning at colleges, educators have begun to explore ways to improve assessment of students' performance. Online learning differs from traditional classroom-based learning in several significant ways. Students and educators in online courses are separated by time and space; access to course materials is continuous; students must become more active learners because of the virtual classroom environment; and the usual evaluative practices may be inappropriate. How can educators modify their assessment techniques in light of the constraints imposed by, and the opportunities afforded by, online classes? The electronic portfolio is gaining popularity among college educators to better reflect the multifaceted learning experiences and outcomes of online courses. While this assessment method is not without potential problems, the electronic portfolio shows substantial promise for resolving many of the difficulties that educators encounter as they strive for improvement in this newest educational format.

Software Tutors Fulfilling Curriculum Topics

Carol Redfield, St. Mary's University, USA

This poster paper presents a mapping of top-level Core Knowledge curriculum topics for grades K through 5 with commercially available computer-based tutors and educational software titles. Many of these tutors could be made available over the Internet. Some of the tutors would be considered 'intelligent' because of the very basic student model represented by a listing of completed sections or information seen by the student in the tutor. Most of the Core Knowledge curriculum topics have at least one tutor that teaches or contains some of the subject matter. This paper also points out topics that are not well covered by existing tutors and compares the coverage to the Texas Essential Knowledge and Skills curriculum topics.

HEPAXPERT-III/WWW: AN INTERACTIVE KNOWLEDGE BASE FOR INTERPRETATION OF SEROLOGIC TESTS FOR HEPATITIS

Clemens Chizzali-Bonfadin, University of Vienna, Austria; Klaus-Peter Adlassnig, University of Vienna, Austria; Andrea Rappelsberger, University of Vienna, Austria

Knowledge-based decision support systems will become more and more important in health care. Based on Internet technology such systems perfectly match the requirements to work in clinical infrastructures for the 21st century. We have developed a fully interactive system based on World Wide Web that interprets serologic tests for hepatitis. HEPAXPERT-III/WWW is a knowledge-based system that interprets the results of qualitative and quantitative routine serologic tests for infection with hepatitis A and B. The system automatically provides and interprets the result of these tests, without the use of additional biochemical or clinical data, and thus helps phy-sicians to understand complex serologic findings. HEPAXPERT-III/WWW can be reached by URL http://medexpert.imc.akh-wien.ac.at/hepax of the World Wide Web. Serologic test results can be entered and will be interpreted immediately. HEPAXPERT-III/WWW is available since April 1998 and it is one of the appli-cations running on our web-based medical knowledge base server MedExpert/WWW.

A Web-Based Case Library to Support Learning

Susan Colaric, Penn State University, USA

Abstract: A Case Library is a collection of cases arranged to allow easy, meaningful access for a user. This Library covers an array of turf problems encountered by golf course superintendents. The cases help fill gaps in a student's knowledge that are a result of their inexperience. Indices to the cases are based on the most salient factors in turf problem-solving. The case was structured to provide a framework that models the thought process users should go though when confronted with a problem as well as to provide the necessary information to make the case meaningful. The deliberate structure of the cases should assist students in using these experiences, drawing productive lessons from them, and encouraging them to build their own "mental libraries" using the framework provided. The cases reside in a database on an SQL server. Active Server Pages are used for easy access to the cases through the indices.

POSTER / DEMONSTRATION ABSTRACTS

Impacting Learning Environments from PreKindergarten Through Graduate School: Technologically Appropriate Professional Development and Classroom Integration Opportunities for Educators

Caroline M. Crawford, University of Houston – Clear Lake, USA

Professional development has historically been a "one-shot" workshop wherein information barrages the learner in a streaming fashion and little to no information is retained. Even more exasperating is the lack of follow-up support once the workshops have concluded. Due to the desire for technologically appropriate professional development and classroom integration opportunities for educators from the PreKindergarten through graduate school levels, a renewed emphasis upon impacting the learning environments through technologically appropriate professional development and classroom integration opportunities for educators has become an exciting area of growth. This article outlines a pilot study wherein professional development opportunities lead the way towards a highly interactive, supportive learning environment.

The technological redesign of two education courses: a work-in-progress

staudt denise, university of the incarnate word, usa; michael risku, university of the incarnate word, usa

Abstract: One of the major obstacles to technology use in K-12 education is the lack of training teachers receive in their university teacher preparation programs. There is a great need for teachers to be technologically literate. This project proposes to redesign two professional education courses (one at the elementary level and one at the secondary level) by creating lessons that model the integration of technology into teaching activities and integrating technologies into requirements for the course.

Bridging the Gender Gap: Girls R.O.C.

Virginia Eaton, University of Louisiana at Monroe, USA; Charlotte Owens, University of Louisiana at Monroe, USA; Kim Taylor, University of Louisiana at Monroe, USA

Girls Research Opportunities in Computing (Girls R.O.C.) is a gender equity program for middle school girls designed to increase interest in computer science. This poster session will present an overview of the program and research findings drawn from pre-tests and post-tests administered to the participants from year one of the program.

Use of Web-based tools for Computer Architecture learning

Isabel Gallego-Fernandez, Universitat Pompeu Fabra, Spain; Jaime Delgado-Merce, Universitat Pompeu Fabra, Spain; Jose Polo-Cantero, Universitat Pompeu Fabra, Spain

The Universitat Pompeu Fabra, at Barcelona, has developed a tool to facilitate teaching and learning: the Global Campus. This provides information, communication (e-mail, discussion forums, chats, on-line talks), administrative and academic tasks management, and learning aid. One of its components is the Global Classroom, one for every subject. We have developed Global Classrooms for the Computers Architecture subjects. They provide: - Study and Reference Material: teaching units to give further information and details about the material taught in class, worded problems with answers, other materials. - Exercises and Laboratory Work: to automatically hand in work carried out in the laboratory, to post exercises, instructions for practical work and course marks. - Teaching Methodology: objectives, schedule, evaluation criteria, index. - Communication: interpersonal communication between professors and students. - Functions: administration of notices, unforeseen events, schedule changes, deadline reminders, general news. - Automatic generation of curriculum, professor information, bibliography, students list, ...

Hyperarchical Instructional Design For Economics Courses

Duane Graddy, Middle Tennessee State University, USA

Student centered learning requires creative pedagogical approaches for presenting ideas and information that challenge learners to expand the depths of their understanding of and receptivity to the subject matter of academic courses. A hyperarchical course structure provides a self-contained pedagogical framework for focusing student attention on the general nature of a subject and its specific content. Elements from Bloom's hierarchy, cognitive flexibility theory, and learner control combine to form the conceptual foundation of the hyperarchical approach. At any point in the interface, the center of the learning environment is an economic principle. Each economic principle is connected to the various levels of cognitive achievement. Students proceed through the hyperarchical environment with varying degrees of learner control. The degree of learner control depends on which cognitive domain the student is working in. Learners are encouraged to explore and discover new learning patterns by linking each principle to a repository of economic data and information.

Development of a Comprehensive Multimedia Presentation for New Employees

Linda Greenwald, Lehigh Carbon Community College, USA; Judith Horvath, Lehigh Carbon Community College, USA

This presentation discusses and demonstrates the CD which was developed for orienting new employees at a small community college in Pennsylvania. The comprehensive multimedia CD orientation process is a unique venture and utilizes state of the art technology. Like most corporations and academic institutions, Lehigh Carbon Community College has historically utilized a two day orientation session offered bi-annually. This process while thorough was in need of enhancements since several issues were on-going: (1) the information provided a cursory overview of the operations of the college (2) newly hired employees have varied start dates and often are not exposed to all of the orientation materials until a substantially later time period (3) the two day orientation process is time intensive and therefore costly in terms of lost productivity The CD development process began with a graphical framework designed by the Vice President of Administrative Services and the Director of Distance Education / Instructional Technology. After the initial framework design was established, the CD development process began by utilizing a multimedia authoring tool. Several multimedia authoring systems were invesitaged (Director 6.0, PowerPoint, Toolbook, Authorware 5.0). Authorware 5.0 was selected due to the graphical interface and complete interface with avi and wav files. The Director of Distance Education / Instructional Technology designed, selected, researched and created graphics, digital video, digital photos, audio clips and text with the assistance of a student worker. The Vice President of Administrative Services coordinated the efforts of the other administrators and staff to elicit information they determined was needed by newly hired employees. Information was supplied by these individuals in Word format, PowerPoint, web links or text (pen/paper). This information was uploaded to the CD by the Director and two students enrolled in the multimedia project class at the college. Enhancements were made to the CD related to student tracking. The voice/audio overlays were created in small segmented wav files to allow easy updating. The CD provides employees with dynamic links to specific college web sites and text, animation, graphics, and video related to the following areas of the college: (1) Virtual campus tour (2) Administrative services (3) Academic offerings (4) Community Services (5) Welcome from the president of the college (6) College mission (7) Personnel issues (8) Computer usage Administrators were provided zip disks with the prototype / demonstration and were asked to complete Phase I evaluations for feedback related to design, content, navigation and appearance. The feedback was incorporated into re-design specifications. The CD is planned to be utilized in Fall (August) 2000. Users will be asked to complete Phase II (Final) Evaluations for feedback to be used in modifications to the CD and updates to be made monthly. Through the utilization of the CD, the college provides more thorough information in a more dynamic delivery method and the CD will serve as a reference to new employees over an extended time period. Since the CD provides a search capability, it will serve as a dynamically interactive multimedia resource.

Telecentres in Chile: A Community Access Project

Pedro Hepp, Universidad de La Frontera, Chile; Ernesto Laval, Universidad de La Frontera, Chile; Rodrigo Garrido, Universidad de La Frontera, Chile

Telecentres in developing countries are being proposed as a community access solution for the use of Internet and information processing services by the more deprived and less educated people. The main challenge is to provide low cost access and to brake cultural barriers that keep people away from using technology. Chile, with close to 3% of its population with Internet access, concentrates most of its users among well educated, high income citizens in its capital city Santiago. In contradiction, many of the services and content already present in Chilean Web pages could directly benefit the population at large. Our project is working on a network of 10 Telecentres in small communities in southern Chile, gathering as much information from each Telecentre user as possible, in order to assess this approach as a possible solution on a larger scale in the near future.

El futuro está ahora: Our Children Working in the WebWorld

Charlie Jackson, 360Commerce, Inc., USA

The future is now (el futuro está ahora) provides a roadmap to issues of education for a world that is centered upon web economy and culture. Ranging from Internet job opportunities to globalization of commerce, this poster session by one of the world's leading technology visionaries brings home the importance of technology literacy within the current school system. It includes observations on cognitive theory, technology development, and the requirements for education in a rapidly changing environment. This session provides a look at how far educational technology has come during the past decade and some of the challenges that lie ahead. It renders a sense of urgency to serving the needs of the current generation of students to meet a future that is already here. The session includes a lively combination of facts, projections, and discussion to motivate the participants to consider new strategies to prepare students for the future.

MediaWarez - an Innovative Web Multimedia Search Service Based on the CBIR Engine

Jinhan Kim, Korea Telecom, Rep. of Korea; Daewon Kim, Korea Telecom, Rep. of Korea; YoungSik Choi, Korea Telecom, Rep. of Korea; Eunil Yun, Korea Telecom, Rep. of Korea; Sanghong Lee, Korea Telecom, Rep. of Korea

As the technologies for the Internet services and network hardware are being advanced, much more peoples are joining Internet world in which many brand-new and unimaginable services are afforded every day. Most of newly afforded services contain multimedia contents such as image, audio, and video. Since conventional search engines are not efficient and adequate for searching and browsing multimedia content, novel searching services for the multimedia content are required. KT(Korea Telecom) has developed a CBIR(Content Based Image Retrieval) engine called KT-MIRS(Korea Telecom - Multimedia Information Retrieval System) for fast and accurate content-based image retrieval. KT has also developed an innovative web multimedia search service called MediaWarez using KT-MIRS. In this paper, functionalities of KT-MIRS and MediaWarez are described.

Continuous Availability and Support for Web-based Applications

Gail Knopp, Mayo Clinic, USA; Glen Swanton, Mayo Clinic, USA

The web presents a new challenge to previous business processes and management structures. In supporting the expansion of web-based applications on an Intranet, talents from a number of different groups must be utilized.

Inegrating New Technologies into the Methods of Education: A PT3 Catalyst Grant

Karla Krueger, University of Northern Iowa, USA; Caroline Lange, University of Northern Iowa, USA

InTime (Integrating New Technologies Into the Methods of Education) is a $2,397,594 Preparing Tomorrow's Teachers to Use Technology Catalyst Grant from the United States Department of Education. The three-year InTime project addresses deficiencies in teacher education programs in preparing preservice teachers to use technology effectively in the PreK-12 classroom. The purpose of InTime is to provide online video best practices and an online discussion forum for methods faculty to use in course revision.

POSTER / DEMONSTRATION ABSTRACTS

Classroom-based Publishing Using the Internet

Maureen Labrum, Chapbooks.com, US; Michael Josefowicz, Chapbooks.com, US; Sam Swope, Chapbooks.com, US;

WorkSpace, a homepage builder for books, is designed to enable groups of people to work together over the Internet to create a book. The technology uses a simple web-form interface; therefore, a teacher does not need to know HTML or any desktop publishing software. One person, usually the teacher, serves as the Editor of the book, and the others are writers. Each writer posts material using any Internet connection and the editor/teacher can then conference with the writers via the WorkSpace forum. The individual writer or the entire class can automatically create page galleys of their pieces at any point in the process. Once the pieces are edited, proofread, and ready to be printed, the Editor can post the book to the Internet with a class password and submit an order for professionally designed paperback copies of their anthology. With this technology, teachers can create online collaborative writing communities that extend beyond the classroom and integrate technology and the writing process.

Accomplishing More by Doing Less - Lessons from Spanish Language Instruction

David Levine, St. Bonaventure University, USA; Kerr Thompson, Gettysburg College, USA

Current trends in foreign language instruction emphasize the use of "creative use of language" - encouraging student conversation even at the price of technical errors. As classroom instruction time is finite, these trends reduce or eliminate the amount of classroom time that is spent on "technical" issues such as vocabulary building (to some degree) and verb conjugation skill (to a much greater degree). To combat this, a small set of simple-to-use tools was created to aid teachers and students in the acquisition of these skills outside of the classroom. These tools are easily customized by the instructor and have been found to be effective with traditional students; there is also evidence that they are particularly effective with learning disabled students. Both WWW and stand-alone versions of the tools will be demonstrated at the conference.

The Cyber Sisters Club: Penn State Lehigh Valley's Technology Outreach Program for Inner City Girls

Judy Lichtman, Penn State Lehigh Valley, USA

Those of us in institutions with ready access to technology can play an important role in bridging the digital divide. At Penn State Lehigh Valley, an outreach program nicknamed the Cyber Sisters Club introduces inner-city minority girls to emerging technologies. The afterschool club brings fifth grade girls who do not have online access to Penn State Lehigh Valley where they learn Internet skills and design personal webpages. The program is designed to encourage girls to become enthusiastic users of technology. The teachers and the physical environment, a "colab" with modular tables and laptops, promote collaboration rather than competition. Creative and social activities, such as webpage design and chat, are included in the program. Women in IT fields at the campus serve as role models. Although new skills are introduced each session, the girls are also given time to explore sites of interest to them. The club website at http://www.lv.psu.edu/jkL1/sisters includes curriculum materials.

Knowledge Management for Executives Learning: MODEL project

Miltiadis D. Lytras, Athens University of Economics and Business, Greece; Georgios I. Doukidis, Athens University of Economics and Business; Greece

One of the most challenging issues in the context of knowledge management is the establishment of dynamic mechanisms that manipulate learning content. The traditional approach since today was limited in static approaches without consideration for the dynamic nature of learning. MODEL integrated framework supports the MODEL tool set, an integrated learning environment especially designed for the specific features of executives learning. The MODEL tool-set is going to combine a multidisciplinary contribution in order to fulfill the generic requirement for the establishment of effective learning mechanisms that maximize the potential usability of learning assets. From this point of view the technological capabilities that will be available to the users have to incorporate facilities that substantially create the web of services needed for the realization of the knowledge wealth. The concept of?MODEL architecture uses four general theoretical concepts: ? The learning templates ? The concept of learning processes ?knowledge product The concept of interactive case studies. The knowledge or educational product consists of six components with specific value for every knowledge worker or trainee: Needs, Knowledge, Motivational Elements, Team Synergy, Problem Solving, Packaging are features that realize the knowledge product. Their combination with the employment of the information and communication technologies provides the necessary workspace for the MODEL toolset. From this perspective the MODEL tool set manipulates in general knowledge products with capabilities to satisfy needs by providing knowledge in a way that enhances the team synergy between teammates in order to solve work-oriented problems. The Learning Processes are well-defined procedures that set the educational scene for the knowledge worker or the trainee in order to understand consciously the value dimension of any specific knowledge product. The learning processes can be presented on a learning cycle, on which the separate and following activities summarize graphically the continuity of the learning effort. The obvious conclusion from this definition is that the role of the information technology for the establishment of learning environments is very critical. Having in mind the diversity of the different learning styles the MODEL tool set must capitalize its effectiveness from its ability to provide a customized way of setting the educational scene for every trainee. In other words the MODEL tool set provides educational scenes that combine different learning processes according to the type of the knowledge product. The Learning Templates are the design tool sets that are used in order to formulate the Knowledge Management Procedure. The interactive case studies finally, are used in order to integrate the previous mentioned concept on a functional level. So MODEL tool set is an advanced knowledge management mechanism which manipulates specific types of knowledge products, namely interactive case studies. MODEL is a project which is funded from the European Commission under the IST Program initiative.

POSTER / DEMONSTRATION ABSTRACTS

FROM CONCRETE TO VIRTUAL - USING A SCIENCE FAIR AND WEB PAGES BUILDING AS STRATEGY FOR THE DEVELOPMENT OF THE CONCEPT OF HYPERTEXT BY ELEMENTARY SCHOOL STUDENTS

Simao Pedro Marinho, Pontifical Catholic University of Minas Gerais, Brazil; Alessandra Marinho, Nossa Senhora das Dores School, Brazil

The students of elementary schools belong to the multimedia generation. They will be dealing with hypertexts much more frequently than their teachers. Our students are using Internet as source to get information useful in the knowledge construction. Teachers must give those students the opportunity to know the hypertext structure by acting directly in its construction. Our 99' Science Exhibition was physically structured so that the school rooms, each one used to the exhibition of one or more themes, became links of an big and concrete hypertext. As complementary activity, the students developed web pages with the main purpose of complementing the themes that they presented in the Science Exhibition. Each room of the school used in Science Exhibition then became pages with links in the WWW. The task was a cooperative work and our students answer to this challenge in a very pleasant way.

Using web site development as strategy to integrate information technology in pre-service teacher education

Simão Pedro Marinho, Pontifical Catholic University of Minas Gerais, Brazil,

In Brazil, pre-service teacher education courses still act as if the computer hadn't existed while pedagogical tool. At PUC Science teacher education, searching for a more dynamic pedagogical structure necessary in the Knowledge Society, we need to prepare teachers to incorporate the new information technologies into the educational work. In a way without relationship with the teaching methods courses, in 1999 we started the Information Technology Pedagogical Initiation Project into the Cytology, discipline of the specific subject curriculum. That Project allows the students to develop important skills, like critical and creativity, to act in a cooperative way and to use problem solving strategies. They develop web pages and other computer uses having the cell as the main subject. The Project is developed as an outclass activity, students use their own computers and shareware/freeware. The pedagogical and technical support is provided by the Cytology teacher.

Pedagogical issues in teaching mathematical, signal processing and physics concepts to non majors

Shruti Mehta, Ohio University, USA

Many of the courses in health sciences have to deal with mathematical, physics-based, electrical circuits and signal processing concepts. Even though these concepts are at an introductory level, most of the students taking these courses, which include physics, signals and circuits do not have the necessary background in Calculus, differential equation or basic electrical engineering courses. The paper details the experience the author has in teaching one such course, "Hearing Science" in the Hearing and Speech Science (HSS) department. Hearing Science is a core course required by the HSS department. It is one of the fundamental courses and a foundation for the advance courses like Psychoacoustics, Physiology of the Ear, Audiology, Pathology of the Ear, Speech Science, Speech production etc. The course entails trigonometric (sine), and logarithmic functions, sound physics, anatomy, physiology, and psychoacoustics. Since the students do not have the prerequisite background in math and physics, the instructor in the past either skipped the concepts which are very critical in understanding and synthesizing details of hearing science like cochlear implants, hearing aids, instrumentation used in the clinic, or the instructor has to spend time in teaching the basic mathematical and signal processing concepts and cannot cover the actual hearing science material planned for the course during that quarter. By developing web-based tools to graphically and interactively let student explore and learn the concept of unit conversion, signals, wave models, psycho acoustic correlations, student can learn these concepts at their own pace and time. Students can review the material anytime from anywhere as long as they have access to the WWW and can go through as many examples/sessions as they need to master/learn those concepts. Since the web-based course/tools development was accomplished before the course started, students could start using the tools immediately and thus have enough time to grasp the information.

Ergonomic Issues for K-12

Vicki Napper, Weber State University, USA; Dennis Ankrum, Nova Solutions , USA

A survey study occurred in 1998 in a southern state. The study population consisted of 302 K-12 schools. The survey had a 70% return rate totaling 212 schools (Elementary:129; Junior High:49; Senior High:34). Survey results indicated computers are used for teaching of non-computer subjects in all schools. Classes in word processing were the most popular. Internet use was common. Fifteen percent of elementary schools reported instructions in programming. Less than 1/4 of the schools reported extensive training in the uses of software. Initial training related to computer software usage appears to have shifted from senior high level courses to elementary schools. In contrast to the common 1:1 workplace ratio of computers to people, an education setting must provide access for an average of seven students per computer. Most schools had furniture for children, but few had customizable environments. Reported data from the survey indicated computer-related visual problems and physical discomfort.

Science and Engineering Online Solution Library for Education

Jun Ni, Academic Technologies, Information Technology Services, The University of Iowa, USA

Abstract: This presentation focuses on an interactive web computing library, Science and Engineering Online Solution Library (SEOSL) for education. The library can be easily integrated into science and engineering web courses for education and online computing application. The library contains about 1000 science and engineering functions based on JavaScript 3.0 programming language, including many computing functions of basic and special functions, matrix and vector operation, linear/nonlinear equations, interpolation, integration, et el. The library has been ranked as one of the top web based engineering and education indexes, and is widely used for online education computing since 1996. The features of SEOSL is presented and discussed. Selected examples of how to integrate SEOSL to engineering course is demonstrated. The future development of online interactive computing for science and engineering is emphasized. SEOSL provides the basis of web based online E-Science and E-Engineering (ES and EE).

The WebAwareness Experience - Enhancing a Website with People

Stefan Nilsson, University of Trollhättan Uddevalla, Sweden; Lars Svensson, University of Trollhättan Uddevalla, Sweden; Fredrik Bengtsson, University of Trollhättan Uddevalla, Sweden; Christian Johansson, University of Trollhättan Uddevalla, Sweden

Most people perceive the World Wide Web primarily as a huge information container, where nodes of information are connected through hyperlinks. To browse the web is like walking in an endless deserted library where books, journals, brochures, video-clips and scraps of papers are spread on the shelves and tables with little or no systematic structure to guide the visitor and no evidence of the presence of other co-visitors can be found Making people visible on the web would open for other forms of user experiences, where information spaces and social spaces merge (Maglio & Barret, 1998). The walk in the deserted library could become more of a visit to a museum, an exhibition or like participating in a study circle or taking a course at the university. Here, the awareness of other people could be prosperous in the sense that they could be used as resources for a variety of purposes. This poster presents and demonstrates a prototype of an Awareware, i.e. a web application that is aimed at making users of a web resource aware of each other. The System provides support for visual and verbal awareness, at present and in the past.

Web Skills Training: Accreditation, Certificates and Certification Exams

Jane Noel, Penn State University, USA

Early practitioners on the web had to rely primarily on a hodge-podge of self-taught skills acquired through books, cruising the web for examples and asking your colleagues for help. Now with the continued demand for skilled Internet professionals there has also been a corresponding demand for training in these areas. This poster session will offer an overview of some of the current training programs available. There will be a particular focus on accreditation and the process followed to become accredited, certificate programs that adhere to current accreditation guidelines, and industry recognized certification tests. A competitive analysis of the programs will list the number of hours of training, costs and accreditations. A sampling of some of the curriculum used as well as the types of questions on the certification exams will also be provided.

USING HIPERMEDIA TECHNICS TO TEACH INFORMATICS

Manuel PerezCota, Universidade de Vigo, Spain; Jacinto GonzalezDacosta, Universidade de Vigo, Spain; Amparo RodriguezDamian, Universidade de Vigo, Spain; Arturo CasarSarasola, Universidade de Vigo, Spain; Maria RodriguezDamian, Universidade de Vigo, Spain

We present a methodology and a tool that can be used to teach Informatics to technical expert people in any field (mechanic, chemistry, etc.). The applied informatics professor has a lot of difficulties to transmit in a web organized and structured way the concepts that define the different terms, theories, diagrams, concepts, and the characteristics and applications of them. Activities: - The organization of the information of the different concepts using hiperlinks to show easily the relation among them. - The use of different resources: Voice, image (static and dynamic), video, in general multimedia. The different concepts of figures are developed in cartoons and those represents the logical components, added the sound. The importance of the developed method is based in that the hipermedia tools permit the use of different formats to represent the associated information in each concept. The contents have been designed using internet based technologies.

WWW-applications in Teaching of Introduction to Power Engineering

Pekka Saari, Tampere University of Technology, Finland; Pekka Laitinen, Tampere University of Technology, Finland; Tuija Mannila, Tampere University of Technology, Finland; Tomi Ristimäki, Tampere University of Technology, Finland; Tommi Keikko Leena Korpinen, Tampere University of Technology, Finland

The aim of the paper is to present the WWW-based methods developed for the course 'Introduction to Power Engineering', which is a basic course of Electric Power Engineering attended annually by nearly 200 students. The WWW-applications used in this course include communications, activity exercises and laboratory registration system. The Internet has replaced traditional bulleting boards, which makes the giving of information easy and fast. The activity exercises are checked automatically by the Perl–script, giving teachers more time to other important things in teaching. Furthermore, the WWW facilitates the delivery of material for the students. Students' opinions on the use of WWW-applications were studied with an inquiry. Based on the experiences and the study, the WWW has been found useful. The feedback has been positive and thus the use of WWW-based applications will be further developed in the future.

Web Based Learning Environment: To Follow the Instructions

Nicoletta Sala, Univeristy of Italian Switzerland, Switzerland

"The net of the nets" is changing the learning processes. In fact the Internet can be used to modify the teaching methods and the process of learning using synchronous and asynchronous education. The aim of this work is to present how to use the Web and its resources in the learning in a high school. I refer an experience in a technical institute in Italy with a sample of 15 students (age 16 - 17). The target was to stimulate the Web learning environment. For this reason the project has been divided in different phases: the knowledge of the Internet (directly in Internet), the didactics using the Internet (in mathematics, in physics, in geometry, in Italian literature, in information technology), the cooperative hypertext (created for an international conference on mathematics), and the communication with the Internet (in particular way the asynchronous communication, e.g. the e-mail).

Developing Website with a Business and a Software Engineering Approach

Joaquim Santos Neto, Rio Sul Airlines / COPPE-UFRJ , Brazil; Luiz Roberto Silva Filho, Rio Sul Airlines / COPPE-UFRJ , Brazil; Jose Roberto Blaschek, COPPE-UFRJ , Brazil; Ana Regina da Rocha, COPPE-UFRJ , Brazil; Carla Valle, COPPE-UFRJ , Brazil

In this article we demonstrate an approach of Business Plan and Software Engineering we used to build a website. We propose a web lifecycle, using Software Engineering and Business Plan principles. We also present an Intention Diagram, which help us designing the information linking. We used this approach on developing Rio Sul's website. Rio Sul is a Brazilian Regional Airlines and a subsidiary of the Varig group.

AUTONOMY AND KNOWLEDGE: COMMENTS ON DISTANCE EDUCATION DESIGN

Luiz A. Senna, University of State Rio de Janeiro (UERJ), Brazil

Autonomy and Knowledge Comments on Distance Education Design Luiz Antonio Gomes Senna Faculty of Education Universidade do Estado do Rio de Janeiro - Brazil - < edu@senna.pro.br > What kind of discussion should lead interdisciplinary teams in charge of mass-education today? What kind of school may emerge within internet? Who should be this virtual school's student? How to conceive him? Distance education design must incorporate some principles derived from basic contemporary policies on Intercultural Education, more specifically concerning to (1) the right to cultural identity and diversity and (2) the right to Education for self development and citizenship. Knowledge and autonomy, under a post-modern point-of-view, are categories that sustain a great part of intercultural education, both concerned to the way one understand human cognition. Classic mass-education midia does not offer good alternatives for intercultural education environments, what may compromise the whole principle of attending everyone wherever they are, even if under severe conditions of social exclusion. Teleinformatic mass-education is potentially more adequate to actual policies on education, but demand an appropriate conceptual support that is still under development.

A Hybrid CD-Internet Delivery System for Pharmaceutical Care Laboratory Instruction

Robert Shrewsbury, University of North Carolina, United States

Abstract: Students can have up to a one week delay between the scheduled pre-lab lecture and their actual laboratory experience. A hybrid CD-Internet CD-ROM was developed to give students rapid, on-demand access to all web-based laboratory information over a telephone modem when outside of the School. The CD-ROM incorporated technology so larger multimedia materials were delivered from the CD-ROM while smaller files were downloaded over telephone modems. Thus the technology avoided problems such as long download times or accessibility to RealPlayer server connections. The benefits of the CD-ROM were evaluated with 1999-2000 academic year students and compared to the previous year's students who did not have the CD-ROM. There was no statistical difference in time to complete the laboratory, grades, or formulation analytical accuracy between the two classes. Students with the CD-ROM preferred to either print the material, or view and print the material compared to viewing the material alone.

The Web: A New Educational Paradigm?

Renato Soffner, State University of Campinas, Brazil; Eduardo Chaves, State University of Campinas, Brazil

The paradigm of printed matter is the reaffirmation of the traditional linear format. That can be seen on the current paradigms of the Web. Although many sites use "links", these show linear form. Another serious limitation of this paradigm is using the Web as an electronic reproduction of a book. Hypertext creates a new situation of discovery and interpretation. In contrast with the linear stream of printed matter, hypertext is fluid, non-linear. Pages of the Web have their proper URL and are not linked to the remaining portion of the document. Thus, each node is independent of what comes before and later. The disadvantage of this view is not allowing the full potential of the new media. Besides being intellectually limited and contrary to the way our minds work. The possibility to allow students to establish non-linear relations between diverse document sources is important in the exploitation of the web potencial.

Business Queries on the Web

Amanda Spink, The Pennsylvania State University, USA; Okan Guner, The Pennsylvania State University, USA

Queries to Web search engines are a primary means for translating people's business information needs in a way that the Web system can understand. Web queries are a key process in e-business. This paper reports a study of business-related queries to the major Web search service - Excite. We analyzed a transaction log of 1.7 million Excite users queries to extract business-related queries. Study results are presented. We found that most people use few search terms, few modified queries, view few Web pages, and rarely use advanced search features. A small number of search terms are used with high frequency, and a great many terms are unique; the language of e-businessWeb queries is distinctive. Queries about recreation and entertainment rank highest. Findings are compared to data from two other large studies of Web queries. This study provides an insight into the beginnings of e-business.

SMILE: Intelligent Learning Environment Accumulating Personal Styles of Users

Svetoslav Stoyanov, Twente University, The Netherlands; Neli Stoyanova, Twente University, The Netherlands

This poster presents some design solutions of building a web-based intelligent learning environment, called SMILE Maker. It accumulates some of the individual constructs such as learning styles, problem solving styles, learning locus of control and level of prior knowledge. The design approach takes into account the large number and different levels of individual constructs, their instability over time, spice and task, and the challenge to develop more style's versatility and flexibility. There are four scenarios metaphorically called Ready-made, Tailor-made, Self-made, and Atelier, available for a selection. Each scenario presents the content within a specific pattern of four learning events - explanation, procedures, examples and practice. SMILE Maker builds up a dynamic individual profile of a learner. It identifies learning styles explicitly or draws an inference implicitly about locus of control, prior knowledge and problem solving styles. A special functionality, called Facilitator, prompts some suggestions according to the behaviour of a learner.

The Classroom of the Future: Use of the Internet, Video Conferencing and SMARTBoards in Inter Site Collaborative Student Projects

Thomas Treadwell, West Chester University, USA; Donna Ashcraft, Clarion University, USA; Bob Mittan, Casper College - UW/CC, USA; Paula Edmiston, Matrix Magic, USA ; Paul Arsenault West Chester University, USA; Adel Barimani, West Chester University, USA; Kelly A. McVeigh West Chester University, USA

The Collaborative On-line Research and Learning (CORAL) Team believes that classrooms, restructured to incorporate technology, should offer more than information exchange and knowledge acquisition; they should provide places where students become active learners collaborating on specific learning objectives. The CORAL model uses various technologies to connect university-level students from several distant sites. Students enrolled in different psychology courses at two universities work with peer writing assistants from a third university to collaboratively produce applied research projects. Teams use discussion boards, chat rooms, email, and video-conferencing to plan, carry out, and present their work. CORAL research indicates that this pedagogy succeeds, encouraging students to become cohesive group members despite the distance between sites, and enabling students to generate products qualitatively equal to or superior to those produced in more traditional courses. Further, this collaborative pedagogy offers students these advantages over traditional courses: opportunities to learn actively, and to improve their communication, problem-solving, and technological skills.

A Prototype Web-based Support System for Classroom Teaching

Yutaka Tsutsumi, Kumamoto Gakuen University, JAPAN; Ryunosuke Fujimoto, Kyushu University, JAPAN; Akira Suganuma, Kyushu University, JAPAN

We are developing a prototype Web-based support system for classroom teaching, called CACCE, Computer Aided Cooperative Classroom Environment. Nowadays, many teachers use Web pages as supplemental materials in the classroom, such as cultural web pages. CACCE is a Web-based software that allows teachers to have control of students' display. We plan to demonstrate CACCE with two PCs. Participants will have the chance to operate the teacher's browser and the student's browser. Participants can do the following controls the student's browser from the teacher's browser: to show specified URL, to freeze student's browser, or to show the mouse pointer to a hot point. Participants can get the configuration of CACCE and manners of it. We hope to encourage additional, creative ideas for the use of this system. We also hope, through our conversation, to distribute our system to participants to experiment in their classroom.

Considerations for the design and development of on-line instruction in software engineering

Shahrzad Vafa, University of Houston-Clear Lake, United States; Edmond Puckett, University of Houston-Clear Lake, United States; Timothy Youngman, University of Houston-Clear Lake, United States

The purpose of this paper is to describe the design process of a graduate-level software engineering course. This paper describes how analyses and assessments are used to identify the level of faculty involvement, set performance objectives, and establish the framework of the course. Moreover, some teaching on-line considerations such as incorporating constructivist and sociocultural theories are outlined. The paper concludes with a brief description of different learning styles and explains how the course accommodates the learning style preferences.

Electronic Portfolios in Assessment of Preservice Teachers

Scott Walker, Our Lady of the Lake University, USA

Electronic Portfolios in Assessment of Preservice Teachers Scott Walker Education Department Our Lady of the Lake University United States walks@lake.ollusa.edu Electronic portfolios are valuable as authentic assessment tools in preservice teacher education programs, as they allow for student demonstration of performance, interconnected tasks, responses, and ambiguity while allowing for learner support. Modeled after an electronic portfolio program in Amsterdam, preservice education students at Our Lady of the Lake University conduct self-assessments based on International Society of Technology in Education (ISTE) standards, set learning goals at the onset of their portfolio projects, and plan and develop a learning contract for portfolio development to meet University computer literacy standards in a meaningful way. This poster session reveals the former "shallow" assessment of preservice teacher computer literacy and the transformation to a more meaningful and authentic means of assessment by which students are encouraged to develop relevant, self-planned, action oriented products to demonstrate their proficiency in technology literacy.

Setanta: a school based intranet project

Ray Walshe, Dublin City University, Ireland; Margaret Farren, Dublin City University, Ireland; Ray O' Neill, St. Aidans C.B.S., Ireland

Abstract: Learning Institutions although often advanced in the development of curriculum, have remained static in the use of technology in teaching and learning. In a world where information communications technologies are much more accessible, we examine how educators can employ these technologies to present subject material in more interesting ways. The visualisation model developed by our educators for Art History was a museum environment where the learners could navigate at their own pace but where the educator had control over the Virtual Art Museum (VAM) content. All data that could be embedded in the VAM is stored in a database on the central server. The educator selects the specific content for the VAM by deciding on a theme. If the educator selected "17th Century Dutch painters" as a theme, all information that satisfies the criteria of the theme is extracted from the database. The retrieved data is used dynamically to create a Virtual 3-D World constructed on the fly using VRML and Java. Once the VAM has been created and placed on the server the learners can browse through the virtual environment. Here they can see the paintings by all the theme artists and can click on embedded links to gain access to information in textual, audio or video format on both the painting and the painter.

Design and Development of Web-based Interactive Tutorials For College Chemistry

Joanne Williams, University of Texas, USA; Jonathan D. Harmon, University of Texas, USA

The design and development of a prototype interactive web-based tutorial for introductory college chemistry courses will be presented during this poster/demonstration. The project utilizes a staff of undergraduate and graduate university students for design and development. The featured tutorial focuses on helping beginning college chemistry students to visualize and comprehend difficult concepts. The positive and negative aspects of utilizing students in the design and development process; plans for further development, and beta and alpha testing will be discussed during this poster demonstration.

Tomorrow's Teachers and Tomorrow's Technology—theT4 Project

Linda Wilson, Langston University / Tulsa, United States

TOMORROW'S TEACHERS AND TOMORROW'S TECHNOLOGY THE T4 PROJECT Abstract for Poster/Demonstration Session# 7197 November 1, 2000 / 6:00-8:00 P.M. Author Dr. Linda Wilson Langston University Tulsa, Oklahoma Educators in northeastern Oklahoma have collaborated on a special three-year project entitled Tomorrow's Teachers and Tomorrow's Technology (T4) Project. The focus of the project will be to deliver a three-year comprehensive professional preparation program for prospective teachers from the northeastern region of Oklahoma for the purpose of empowering teachers with the technological skills necessary for effectively teaching in twenty-first century schools. The T4 Project is unique for two distinctive reasons. The two primary institutions involved are Tulsa Community College (TCC) and Langston University / Tulsa. Our project was the only one to receive funding which paired a junior college with a university. The T4 Project is also unique because of the B.Y.T.E.S. program, a summer program for teacher education majors in which the students work in the business world using business computers during their internship.

Gender Equality Through Technology: Dimensions of a New Approach

Timothy Youngman, University of Houston, United States

Abstract: Few would argue that providing education for all is a viable and worthwhile goal. For years educators have struggled with decisions about how to give students the opportunity to reach their maximum potential. A possible way to equalize educational experiences is to facilitate interactions in a virtual community where identity is masked. In such an environment, the essence of each person's thoughts can come through and stand on its own merit rather than be judged on the basis of who expressed the ideas. This can be achieved in a synchronous chat room when all people use gender-free, culture-free names. This form of communication has the potential to alleviate some of the problems caused by the struggles for power in the classroom. This presentation will provide an overview of a study that is currently being conducted at a large urban university in the southern United States.

Using animation on the Web in teaching plant biology

Chong Ho Yu, Arizona State University, USA; Ruvi Wijesuriya, Arizona State University, USA; Angel Jannasch-Pennell, Arizona State University, USA; Samuel DiGangi, Arizona State University, USA; Leslie Towill, Arizona State University, USA

This paper describes the design, development, and delivery processes of multimedia modules such as Macromedia Flash, Shockwave movies, and Quicktime movies. These modules were employed to teach a undergraduate plant biology class at a large southwest university. Each medium has different strengths and weaknesses and their proper use resulted from the collaboration among the content experts, instructional designers, and multimedia developers.

Web-Based Learning and Instruction Support System (WBLISS)

Steve Yuen, University of Southern Mississippi, USA; Patrivan Yuen, William Carey College, USA

Web-Based Learning and Instruction Support System is our attempt to apply the performance support system concept to some of the problems of higher education. We wanted WBLISS to augment the initial instruction that the instructional technology students received in the classroom. We also wanted the system to be useful to both new and experienced students who need assistance with specific tasks and procedures while working on projects outside of class. This poster/demonstration session will show our latest results and developments in WBLISS and demonstrate how our self-paced, Web-based, and interactive learning system can assist users in learning and provide just-in-time training, information, help, and advice to users in different training topics.

Beyond Bookmarks: Enriching Web Information. A demonstration of the NESTOR Web Browser and Cartographer

Romain Zeiliger, CNRS-GATE, France

Web users rely on bookmarks to build personal information spaces consisting of focused subsets of information relevant to their work context. To overcome bookmarks drawbacks we have developed NESTOR a Web browser and cartographer based on Internet Explorer that draws customizable navigation maps (http://www.gate.cnrs.fr/~zeiliger/nestor.nestor.htm). Constructing personal and shared information spaces with NESTOR you proceed along a four stages activity: 1) navigating the Web and gathering information into maps 2) enriching the maps through adding annotations, personal documents and new links 3) structuring the map content through creating conceptual areas, annotated paths, concept networks thus steadily transforming the originally navigation maps into more conceptual maps 4) collaboratively defining shared maps. In giving users means to capitalize and conceptualize their Web experiences NESTOR promotes a constructivist approach to Web navigation. It can be used as an integrated bookmark system that scale-up to manage archives of a few thousand URLs.

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